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Serial No. 09/712,144	Filing Date November 15, 2000	Examiner M. Wimer	Group Art Unit 2821

Invention: **ANTENNA DEVICE FOR TRANSMITTING AND/OR RECEIVING RADIO FREQUENCY WAVES AND**

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ALL.010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION of

Christian Braun, et al.

Group Art Unit: 2821

Serial No.: 09/712,144

Examiner: M. Wimer

Filed: November 15, 2000

For: ANTENNA DEVICE FOR TRANSMITTING AND/OR RECEIVING RADIO FREQUENCY WAVES AND METHOD RELATING THERETO

BRIEF ON APPEAL BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Honorable Assistant Commissioner of
Patents and Trademarks,
Washington, D.C. 20231

Date: January 2, 2003

Sir:

Per the Notice of Appeal to the Board of Patent Appeals and Interferences, mailed October 1, 2001, Applicants, by their Attorney hereby provide a Brief on Appeal under 37 C.F.R.§ 1.192 in triplicate. Petition is hereby made for a one month extension of time under 37 C.F.R. § 1.136(a), extending the period of response from December 1, 2002 to January 2, 2003. Permission is given to charge the required fee for the one-month extension of time under 37 C.F.R.§ 1.17(a)(1) to Deposit Account Number 50-0238. Finally, permission is hereby given to charge Deposit Account Number 50-0238 for the fee required under 37 C.F.R.§ 1.17(c) for filing

of the present Brief on Appeal.

1. Real Party in Interest

The real party in interest as Assignee of entire right and title is ALLGON, AB, having its principal place of business at P.O. Box 500 SE-184, Aksersberga, Sweden.

2. Related Appeals and Interferences

There are no known related appeals and interferences at this time.

3. Status of Claims

Claims 1 - 29, 31-33 and 35-38 are pending presently. All pending claims have been finally rejected.

4. Status of Amendments

A final Office Action was mailed on June 18, 2002, rejecting all pending claims and objecting to none. A request for reconsideration was mailed on August 30, 2002, prompting an Advisory Action mailed on September 23, 2002. The Advisory Action indicated that the Request for Reconsideration was considered but did not place the application in condition for Allowance.

5. Summary of the Invention

Fig. 1 shows an antenna device 2 in accordance with an exemplary embodiment of the present invention. Reference numerals 20, 21 are the front part and the back part, respectively, of the casing of a portable telephone. The main printed circuit board, PCB, of the phone is intended to be mounted in the space 1 in the front part of the casing. The antenna device 2 comprises a switching device 4. The switching device 4 comprises a matrix of electrically controllable switching elements. Switching device 4 is surrounded by an antenna structure comprising a pattern of antenna elements. Each

antenna element is connected to a respective switch in the switching device arranged for connecting and disconnecting the antenna element. In this embodiment the radiating structure comprises four loop-shaped antenna elements 5. Within each of the loops 5 a loop-shaped parasitic element 6 is formed. Between each pair of loop-shaped elements 5, 6 a meander-shaped antenna element 7 is arranged. The antenna elements form a symmetrical pattern around the switching device 4. However, in certain applications the antenna elements can form an unsymmetrical pattern. Further, the radiation structure can include additional antenna elements not connected to the switching device. (Please refer to page 7, lines 12-24 for support for this assertion.)

The switching device 4 allows the antenna structure to be selectively switchable between a number of antenna configuration states, each of which is distinguished by a set of radiation parameters, such as resonance frequency, input impedance, bandwidth, radiation pattern, gain, polarization and near-field pattern. (Please refer to page 6, line 27- page 7, line 30 for further details of the embodiment of Fig.1.)

According to an exemplary embodiment of the present invention, there is provided an antenna device for transmitting and/or receiving RF radiation, which is installable in and connectable to a radio communication device. The antenna device comprises an antenna structure, which is switchable between a plurality of antenna configuration states. Each antenna configuration state is distinguished by a set of radiation parameters, such as resonance frequency, input impedance, bandwidth, radiation pattern, gain, polarization, and near-field pattern. Further, the antenna comprises a switching device for selectively switching the antenna structure between the plurality of antenna configuration states. The antenna configuration states are chosen based

on a predefined physical operation environment. (Please refer to page 5, lines 11-25 of the application as filed for support for this assertion.)

In the application as filed, examples of the predefined physical operation environment are given, and include a talk position, a free space position, a waist position, and a pocket position. Common to all predefined physical operation environments is that they are in close proximity to the antenna device. Moreover, the plurality of antenna configuration states is distinguished between a set of radiation parameters. As such, based on the particular predefined physical operation state that exists, a particular antenna configuration state is chosen. If the physical operation state changes, the antenna configuration state is changed. (Please refer to the application as filed at page 5, lines 22-27; and page 13, lines 5- 26 for support for this assertion.)

It is noted that the term 'predefined physical operation environment' the context of the present invention refers to a close-by environment, which comprises objects that affect the above-mentioned parameters of the antenna structure, particularly when being installed in a small-sized radio communication device. Moreover, 'close-by operation environment' refers to any object at a distance from the radio communication device within which the effect on the antenna parameters is noticeable. This distance may extend ten wavelengths from the device, but optionally it may extend five wavelengths, a few wavelengths, or only roughly about one wavelength from the device. The environment includes of course the user of the communication device. (Please refer to page 5, line 28- page 6, line 7 for further support for this assertion.)

A plurality of antenna configuration states includes different numbers of connected antenna elements. For example, the antenna configuration states may be obtained by connecting

loop-shaped antenna elements in parallel or in series with each other, or some elements can be connected in series and some in parallel. Further, one or more elements can be completely disconnected or connected to a RF ground plane means. One or more of the meander-shaped antenna elements 7 can be used separately or in any combination with the loop antenna elements. The meander elements can also be segmented so that only one or more selected portions thereof can be connected if desired.

Exemplary embodiments of the present invention comprise various approaches for sensing the physical operation environment and various procedures for controlling the switching of the antenna device. An example of such a change is discussed in the application as filed. In the example, the change of physical operation state is from free space position to talk position. To compensate for the change in the resonance frequency caused by the user, switch 49 is opened, and the electrical length of the connected antenna structure is reduced, and the resonance frequency is increased. As such, with an appropriate design of an antenna structure and switching device 36, the increase in the resonance frequency compensates for the reduction as introduced by the change in physical operation state from free space to talk position. (Please refer to page 14, line 27-page 15, line 7 of the application as filed.)

According to exemplary embodiments of the present invention, a sensor may be provided for detecting a physical property of a selected close-by environment. In this manner, objects on different sides of the device may be sensed. The control device of the antenna receives a measure of a detected physical property of the operation environment. This detected physical property may be sensed from at least one of a resistive, capacitive, inductive, optic, temperature, pressure, inclination, orientation, and motion sensor. In any event, the sensing performed

according to exemplary embodiments is of a detected physical property of the operation environment. (Please refer to page 17, line 3- page 18, line 6 of the application as filed for support for these assertions.)

6. Issues

The issue on appeal is whether claims 1-29, 31-33 and 35-38 are properly rejected under 35 U.S.C. § 102(b).

7. Grouping of Claims

Group I: Claims 1, 8 - 12, 14-16, 18-23 and 35 stand or fall together.

Group II: Claims 5, 6 and 7 stand or fall together.

Group III: Claim 13 stands or falls alone.

Group IV: Claim 21 stands or falls alone.

Group V: Claim 26 stands or falls alone

Group VI: Claims 24, 25, 27, 28 and 36 stand or fall together.

Group VII: Claims 29 and 37-38 stand or fall together.

Group VIII: Claims 31-32 stand or fall together.

Group IX: Claims 33 and 34 stand or fall together.

8. Argument

I.

Claims 1-29, 31-33 and 35-38 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Kuffner, et al.* (U.S. Patent Number 5, 486,836). Of these, claims 1, 24, 29, 31 and 33 are independent claims. For at least the reasons that follow, Applicant asserts that the

Office Action has not met the initial burden of supporting a *prima facie* case of anticipation; and, therefore, this rejection in view of *Kuffner, et al.* is improper and should be withdrawn.

A proper rejection for anticipation " . . . requires, as the first step in the inquiry, that *all the elements* of the claimed invention be described in a *single* reference." *In re Spada* 15 USPQ.2d 1655, 1657 *(1990),* (emphasis added). A necessary corollary to this test of anticipation is that the " . . . absence of any claimed element from the reference negates anticipation." *Kloster-Speedsteel AB v. Crucible, Inc.* 230 USPQ 81, 84 (1986). Furthermore, it is established that in determining anticipation, " . . . the claims are read in the context of the patent specification in which they arise and in which the invention is described." *Glaverbel Societe Anonyme v. Northlake Marketing & Supply Inc.* 33 USPQ 2d 1496, 1498. (Fed. Cir. 1996). Moreover, it is established that "In deciding the issue of anticipation, the trier of fact must identify the elements of the claims, determine their meaning in light of the specification and prosecution history and identify corresponding elements in the allegedly anticipating reference." *Glaverbel* at 1498.

Claim 1 is drawn to an antenna structure switchable between a plurality of antenna configuration states, each of which is distinguished by a set of radiation parameters, and:

"...each of said plurality of antenna configuration states is adapted for use of the antenna device ***in a respective predefined physical operation environment."***

Independent claims 24, 29, 31 and 33 also include similar limitations.

According to Applicants specification as filed, the term 'predefined physical operation environment' refers to a close-by environment, which comprises objects that affect the above-

mentioned parameters of the antenna structure, particularly when being installed in a small-sized radio communication device. In keeping with *Glaverbel* it is respectfully submitted that the determination of anticipation the elements of the claims must be identified and their meaning determined meaning in light of the specification. Below, the element 'predefined physical operation environment' is discussed in the context of the specification as filed. It is respectfully submitted that a teaching of at least the element 'predefined physical operation environment' is not found in the teaching of *Kuffner, et al.*

In the application as filed, examples of the predefined physical operation environment are given, and include a talk position, a free space position, a waist position, and a pocket position. Common to all predefined physical operation environments is that they are in close proximity to the antenna device. Moreover, the plurality of antenna configuration states is distinguished between a set of radiation parameters. As such, based on the particular predefined physical operation state that exists, a particular antenna configuration state is chosen. If the physical operation state changes, the antenna configuration state is changed. (Please refer to the application as filed at page 5, lines 26-27).

An example of such a change is discussed in the application as filed. In the example, the change of physical operation state is from free space to talk position. To compensate for the change in the resonance frequency caused by the user, switch 49 is opened, and the electrical length of the connected antenna structure is reduced, and the resonance frequency is increased. As such, with an appropriate design of an antenna structure and switching device 36, the increase in the resonance frequency compensates for the reduction as introduced by the change in physical

operation state from free space to talk position. (Please refer to page 14, line 27-page 15, line 7 of the application as filed.)

The reference to *Kuffner, et al.* neither teaches nor suggests such a limitation. To this end, the reference to *Kuffner, et al.* is drawn to a dual rectangular patch antenna system and radio for providing isolation and diversity, while eliminating the need for a diplexer or a second transmit/receive switch. The reference to *Kuffner, et al.* introduces impedance isolation, and fosters spatial and polarization diversity by switching between two patch antennas.

As is known, spatial diversity pertains to the mitigation of one type of multi-path interference (MPI). For purposes of illustration, MPI can result in reduced signal strength due to destructive interference signals due to reflection, and unequal path length from a transmitter in general.

Polarization diversity is a technique whereby information may be sent over two states of polarization of a signal. It is useful to mitigate changes in a desired polarization state as the signal is transmitted/received across a link. For example, interference as detailed above in connection with spatial diversity section can adversely impact the polarization state of a signal. Of course, this phenomenon relates to a difference in the electrical path length of the signal, and other factors could result in the loss of polarization.

While the reference to *Kuffner, et al.* teaches the selection of one of the patch antennas based on signal strength (RSSI), this is the measure of the received signal strength and not the adaptation for use of the antenna device based on a physical property of the operation environment; rather the selection base on the received signal strength regardless of the

environment. Stated differently the invention of claim 1 includes the choosing of a particular antenna configuration based on a particular physical operation environment, regardless of the quality of the received signal.

As such, the reference is drawn to mitigating the adverse affects of interference with the signal, **and not adapting the antenna structure to accommodate a change in the physical operation environment** as is recited in claim 1.

Accordingly, for at least the reasons set forth above, the reference to *Kuffner, et al.* fails to disclose at least the claimed element of claim 1 discussed above. Similarly, it is respectively submitted that the portions of independent claims 24, 29, 31 and 33 that correspond to the elements of claim 1 discussed immediately above define over the teachings of *Kuffner, et al.* Therefore, *Kuffner, et al.* cannot serve to establish a prima facie case of anticipation of these claims as has been asserted in the Office Action. For at least this reason, withdrawal of the rejection of claims 1, 24, 29, 31 and 33, and the claims that depend directly or indirectly therefrom, is respectfully requested.

Claim 29 includes common elements with claim 1 discussed above, and it is respectfully submitted that the germane arguments set forth above are pertinent to claim 29 as well. Moreover, claim 29 also recites a control device which receives a detected physical property of an operation environment that is external to the antenna device:

"*...wherein a measure of the detected physical property is received from at least one of a sensor, particularly a resistive sensor, capacitive, inductive, optic, temperature, pressure, inclination, orientation, or motion sensor.*"

In this manner, objects on different sides of the device may be sensed.

It is respectfully submitted that the reference to *Kuffner, et al.* does not teach nor suggest the recited elements of claim 29. To this end, while the reference to *Kuffner, et al.* does disclose the selection of one of the patch antennas based on signal strength (RSSI), this is the measure of the received signal strength and not the detection or measure of a physical property of the operation environment. Moreover, the reference to *Kuffner, et al.* does not disclose the sensors recited above. (Please refer. for example, to column 5, lines 39-42; and column 6 lines 44-52 of *Kuffner, et al.* for support for this assertion.)

Accordingly, for at least the reasons set forth above, the reference to *Kuffner, et al.* fails to disclose at least the claimed element of claim 29 discussed above. Therefore, *Kuffner, et al.* cannot serve to establish a *prima facie* case of anticipation of this claim as has been asserted in the Office Action. For at least this reason, withdrawal of the rejection of claim 29, and the claims that depend directly or indirectly therefrom is respectfully requested. In addition, claims 13 and 33 includes a similar limitation to that of claim 29 recited above. Accordingly, for reasons substantially identical to those discussed above, the rejections of claims 13 and 33 in view of *Kuffner, et al.* are believed to be improper, and should therefore be withdrawn.

Claim 31 includes common elements of claim 1, and also specifically includes a control device that receives a measure of a detected physical property of operation, and a measure of a second detected physical property. The use of the measure of two detected physical properties fosters safer identification of the operation environment, allowing more reliable control of the switching device.

For reasons consistent with those discussed above in connection with claim 29, it is respectfully asserted that the reference to *Kuffner, et al.* fails to teach or suggest one detected physical property of operation. Therefore, *Kuffner, et al.* cannot be relied upon for the teaching of two detected physical properties as is specifically claimed. As such, the reference to *Kuffner, et al.* lacks a teaching of at least one of the claimed elements of claim 31, and cannot serve to establish a prima facie case of anticipation as asserted in the Office Action. For at least this reason, withdrawal of the rejection of independent claim 31, and claim 32, which depends therefrom is respectfully requested.

Claim 21 is dependent from claim 1, and delimits the antenna device to an antenna structure with a switchable antenna element having at least one of a meander, slot, patch, whip helical, spiral and fractal configurations. The reference to *Kuffner, et al.* includes patch antennas, but is void of a teaching any of the other antenna configurations of this claim. As such, the reference to *Kuffner, et al.* lacks a teaching of at least one of the claimed elements of claim 21, and cannot serve to establish a prima facie case of anticipation as asserted in the Office Action. Withdrawal of this rejection is respectfully requested.

Claim 26 is dependent from claim 24, and delimits the method of selective switching. The claim further recites that:

"...said one and another antenna configuration states being adapted for use of the antenna device in said radio communication device in any two of the ***following said predefined physical operation environments: a talk position, a free space environment, a waist position, and a pocket position.***"

The reference to *Kuffner, et al.* neither teaches nor suggests such a limitation. As stated above, the reference to *Kuffner, et al.* is drawn to a dual rectangular patch antenna system and radio for providing isolation and diversity, while eliminating the need for a diplexer or a second transmit/receive switch. The reference to *Kuffner, et al.* introduces impedance isolation, and fosters spatial and polarization diversity by switching between two patch antennas, but does not teach the adaptation of antenna configuration states in any two predefined physical operation environments as recited above. Clearly, the selection of an antenna for transmission or reception base on RSSI is disclosed in *Kuffner, et al.*, but not the elements of claim 26. Accordingly, *Kuffner, et al.* cannot serve to establish a prima facie case of anticipation as asserted in the Office Action. Withdrawal of this rejection is respectfully requested.

Finally, claim 17 depends from claim 1, and further delimits the plurality of antenna configurations states to include *different numbers of connected antenna elements*. In the filed application, these antenna elements are connected (and disconnected) enabling the antenna structure to be selectively switchable between a number of antenna configuration.

In contrast to the recited limitation of claim 17, the reference to *Kuffner, et al.* teaches the selection of a patch antenna for signal reception and a patch antenna for signal transmission via a switch, **but does not teach the connection of antenna elements** as set forth in claim 17. For example, referring to *Kuffner, et al.* at column 5, lines 15-25, the first switch 506 allow for the *selection* of feedpoints of one of the first or second rectangular patch antennas 502 and 504 for signal reception; and the second switch 508 allows for the selection of feedpoints of one of the feedpoints of the first or second patch antennas for signal transmission. However, the two

antenna elements **are not connected** as is claimed. Accordingly, *Kuffner, et al.* cannot serve to establish a prima facie case of anticipation of claim 17 as asserted in the Office Action. Withdrawal of this rejection is respectfully requested.

9. Conclusion

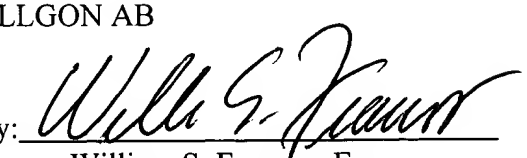
For the reasons set forth above, claims 1 - 29, 31-33 and 35-38 are believed to be in condition for allowance. Allowance is earnestly solicited.

In the event that there are any outstanding matters remaining in the present application, the Examiner is invited to contact William S. Francos (Reg. No. 38,456) at (610) 375-3513 in Wyomissing, Pennsylvania, to discuss these matters.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-0238 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted on behalf of,

ALLGON AB

By: 

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APPENDIX 1

Claims:

1. An antenna device for transmitting and/or receiving RF radiation, installable in and connectable to a radio communication device, and comprising;

- an antenna structure switchable between a plurality of antenna configuration states, each of which is distinguished by a set of radiation parameters, such as resonance frequency, input impedance, bandwidth, radiation pattern, gain, polarization, and near-field pattern, and

- a switching device for selectively switching said antenna structure between said plurality of antenna configuration states, wherein

- each of said plurality of antenna configuration states being adapted for use of the antenna device in said radio communication device in a respective predefined physical operation environment.

2. The antenna device as claimed in claim 1, wherein each predefined physical operation environment is defined by objects affecting electromagnetic radiation and located within a distance from said communication device of less than ten wavelengths of the electromagnetic radiation.

3. The antenna device as claimed in claim 1, wherein said radio communication device is a wireless hand-portable radio communication device.

4. The antenna device as claimed in claim 1, wherein one of said plurality of antenna configuration states is adapted for use of the antenna device in said radio communication device in a talk position.

5. The antenna device as claimed in claim 1, wherein one of said plurality of antenna configuration states is adapted for use of the antenna device in said radio communication device in a free space environment.

6. The antenna device as claimed in claim 1, wherein one of said plurality of antenna configuration states is adapted for use of the antenna device in said radio communication device in a waist position.

7. The antenna device as claimed in claim 1, wherein one of said plurality of antenna configuration states is adapted for use of the antenna device in said radio communication device in a pocket position.

8. The antenna device as claimed in claim 1, wherein a control device is arranged to receive an indicator which indicates a change from a first to a second of said predefined physical operation environments and which controls said switching device to switch said antenna structure from a first to a second of said plurality of antenna configuration states, in accordance with said indicator.

9. The antenna device as claimed in claim 8, wherein said indicator represents a reflection coefficient of said radio communication device.

10. The antenna device as claimed in claim 8, wherein said indicator represents an operation state of said radio communication device.

11. The antenna device as claimed in claim 1, wherein a control device receives a measure of a detected physical property of an operation environment, said operation environment being external to said antenna device and to the communication device having the antenna device installed therein, and controls said switching device, and hence the selective switching of said antenna structure between said plurality of antenna configuration states, in accordance with said measure.

12. The antenna device as claimed in claim 11, wherein the measure of the detected physical property of the operation environment is received from a sensor.

13. The antenna device as claimed in claim 12, wherein the measure of the detected physical property of the operation environment is received from a resistive, capacitive, inductive, optic, temperature, pressure, inclination, orientation, or motion sensor.

14. The antenna device as claimed in claim 11, wherein the control device is receives a second measure of a second detected physical property of the operation environment, and controls said switching device, and hence the selective switching of said antenna structure between said plurality of antenna configuration states, in accordance with said second measure.

15. The antenna device as claimed in claim 14, wherein the detected physical properties are derived from different spatial portions of the operation environment.

16. The antenna device as claimed in claim 15, wherein the detected physical properties are of different nature.

17. The antenna device as claimed in claim 1, wherein the plurality of antenna configuration states comprise different numbers of connected antenna elements.

18. The antenna device as claimed in claim 1, wherein the plurality of antenna configuration states comprise differently arranged RF feed connections.

19. The antenna device as claimed in claim 1, wherein the plurality of antenna configuration states comprise differently arranged RF ground connections.

20. The antenna device as claimed in claim 1, wherein said switching device comprises a microelectromechanical system (MEMS) switch device.

21. The antenna device as claimed in claim 1, wherein said antenna structure includes a switchable antenna element having any of meander, loop, slot, patch, whip, helical, spiral and fractal configurations.

22. The antenna device as claimed in claim 1, wherein said antenna structure comprises a transmitting antenna structure and a receiving antenna structure, and said plurality of antenna configuration states comprise a plurality of antenna configuration states for the transmitting antenna structure and a plurality of antenna configuration states for the receiving antenna structure, each antenna structure being switchable independently of each other between its respective plurality of antenna configuration states.

23. A radio communication device comprising an antenna device according to claim 1.

24. A method for transmitting and/or receiving RF radiation in an antenna device including a switchable antenna structure installable in and connectable to a communication device, the method comprising:

- adapting each of a plurality of antenna configuration states, each antenna configuration state being distinguished by a set of radiation parameters, in the switchable antenna structure for use of the antenna device in the communication device in a respective predefined physical operation environment; and

- selectively switching the switchable antenna structure between said plurality of antenna configuration states.

25. The method as claimed in claim 24, wherein each said predefined physical operation environments are defined by objects affecting the RF radiation and located within a distance from said radio communication device of less than ten wavelengths of said RF waves.

26. The method as claimed in claim 24, wherein said selective switching is performed from one to another of said plurality of antenna configuration states, said one and another antenna configuration states being adapted for use of the antenna device in said communication device in any two of the following said predefined physical operation environments: a talk position, a free space environment, a waist position, and a pocket position.

27. The method as claimed in claim 24, further comprising controlling said selectively switching with a received measure indicating a change from a first to a second of said predefined physical operation environments and said switching device to switch said antenna structure from a first to a second of said plurality of antenna configuration states, in accordance with said measure.

28. The method as claimed in claim 24, further comprising controlling said selectively switching with a measure of a detected physical property of an operation environment, the environment being external to said antenna device and to said radio communication device having the antenna device installed therein, to switch said antenna structure between said plurality of antenna configuration states, in accordance with the measure.

29. An antenna device for transmitting and receiving radio frequency waves, installable in a radio communication device, and comprising:

- an antenna structure switchable between a plurality of antenna configuration states, each antenna configuration state being distinguished by a set of radiation parameters;

- a switching device which selectively switches said antenna structure between said plurality of antenna configuration states; and

- a control device which receives a detected physical property of an operation environment, said operation environment being external to the antenna device and to the radio communication device having the antenna device installed therein, and which controls said switching device, and the selective switching of said antenna structure between said plurality of antenna configuration states, in accordance with said detected physical property,

wherein a measure of the detected physical property of the operation environment is received from at least one of a sensor, particularly a resistive, capacitive, inductive, optic, temperature, pressure, inclination, orientation, or motion sensor.

31. (Amended) An antenna device for transmitting and receiving radio frequency waves, installable in a radio communication device, and comprising:

- an antenna structure switchable between a plurality of antenna configuration states, each antenna configuration state being distinguished by a set of radiation parameters;

- a switching device which selectively switches said antenna structure between said plurality of antenna configuration states; and

- a control device which receives a detected physical property of an operation environment, said operation environment being external to the antenna device and to the radio communication device having the antenna device installed therein, and which controls said switching device, and the selective switching of said antenna structure between said plurality of antenna configuration states, in accordance with said detected physical property,

wherein the control device receives a measure of a second detected physical property of the operation environment, and controls said switching device, and hence the selective switching of said antenna structure between said plurality of antenna configuration states, in dependence on said second measure.

32. The antenna device as claimed in claim 31, wherein the detected physical properties are derived from different spatial portions of the operation environment.

33. In an antenna device installable in a communication device, and comprising

- an antenna structure switchable between a plurality of antenna configuration states, each of which is distinguished by a set of radiation parameters; and

- a switching device which selectively switches said antenna structure between said plurality of antenna configuration states,

a method for transmitting and receiving radio frequency waves comprising:

- receiving a detected physical property of an operation environment, the operation environment being external to the antenna device and to the communication device having the antenna device installed therein; and

- controlling said switching device, and the selective switching of the antenna structure between the plurality of antenna configuration states, in dependence on the detected physical property,

wherein a measure of the detected physical property of the operation environment is received from a sensor, the sensor being one of a resistive, capacitive, inductive, optic, temperature, pressure, inclination, orientation or motion sensor.

33. In an antenna device installable in a radio communication device, and comprising

- an antenna structure switchable between a plurality of antenna configuration states, each of which is distinguished by a set of radiation parameters, such as resonance frequency, input impedance, bandwidth, radiation pattern, gain, polarization and near-field pattern; and

- a switching device for selectively switching said antenna structure between said plurality of antenna configuration states,

a method for transmitting and receiving radio frequency waves comprising the steps of:

- receiving a detected physical property of an operation environment, said environment being external to said radio antenna device and to said radio communication device having the antenna device installed therein; and

- controlling said switching device, and the selective switching of said antenna structure between said plurality of antenna configuration states, in dependence on said detected physical property.

35. The antenna device as claimed in claim 1, wherein said set of radiation parameters includes at least of one resonance frequency, impedance, radiation pattern, polarization and bandwidth.

36. The method as claimed in claim 24, wherein said set of radiation parameters includes at least

of one resonance frequency, impedance, radiation pattern, polarization and bandwidth.

37. The antenna device as claimed in claim 29, wherein said set of radiation parameters includes at least of one resonance frequency, impedance, radiation pattern, polarization and bandwidth.

38. The method as claimed in claim 33, wherein said set of radiation parameters includes at least of one resonance frequency, impedance, radiation pattern, polarization and bandwidth.

APPENDIX 2

Reference Relied Upon by the Examiner

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US005486836A

United States Patent [19]

Kuffner et al.

[11] Patent Number: 5,486,836

[45] Date of Patent: Jan. 23, 1996

[54] METHOD, DUAL RECTANGULAR PATCH ANTENNA SYSTEM AND RADIO FOR PROVIDING ISOLATION AND DIVERSITY

[75] Inventors: Stephen L. Kuffner, Algonquin; Scott N. Carney, Palatine; Eric L. Krenz, Crystal Lake, all of Ill.

[73] Assignee: Motorola, Inc., Schaumburg, Ill.

[21] Appl. No.: 389,540

[22] Filed: Feb. 16, 1995

[51] Int. Cl.[6] H01Q 1/38

[52] U.S. Cl. ..... 343/700 MS; 343/702; 343/853

[58] Field of Search ..... 343/700 MS, 702, 343/725, 830, 846, 844, 853, 876; H01Q 1/38

[56] References Cited

U.S. PATENT DOCUMENTS

4,538,153	8/1985	Taga	343/700 MS
5,201,065	4/1993	Niehenke	343/700 MS
5,223,848	6/1993	Rammos et al.	343/853
5,270,722	12/1993	Delestre	343/700 MS
5,371,507	12/1994	Kuroda et al.	343/700 MS
5,410,322	4/1995	Sonoda	343/700 MS

OTHER PUBLICATIONS

Yeshihide Yanmada, Yeshie Ebine and Kenichi Tsunckawa, "Base and Mobile Station Antennas for Land Mobile Radio Systems" Invited Papers, Special Issue on Mobile Communications, Mar. 11, 1991, pp. 1547–1555.

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Assistant Examiner—Tan Ho
Attorney, Agent, or Firm—Darleen J. Stockley

[57] ABSTRACT

The present invention provides a method, dual rectangular patch antenna system, and radio for providing isolation and diversity while eliminating the need for a diplexer or a second transmit/receive switch. The dual rectangular patch antenna system comprises a first rectangular patch antenna (202), a second rectangular patch antenna (204), and a switch (206). Receive path diversity is provided by switching between the first rectangular patch antenna (202) and the second rectangular patch antenna (204).

16 Claims, 6 Drawing Sheets

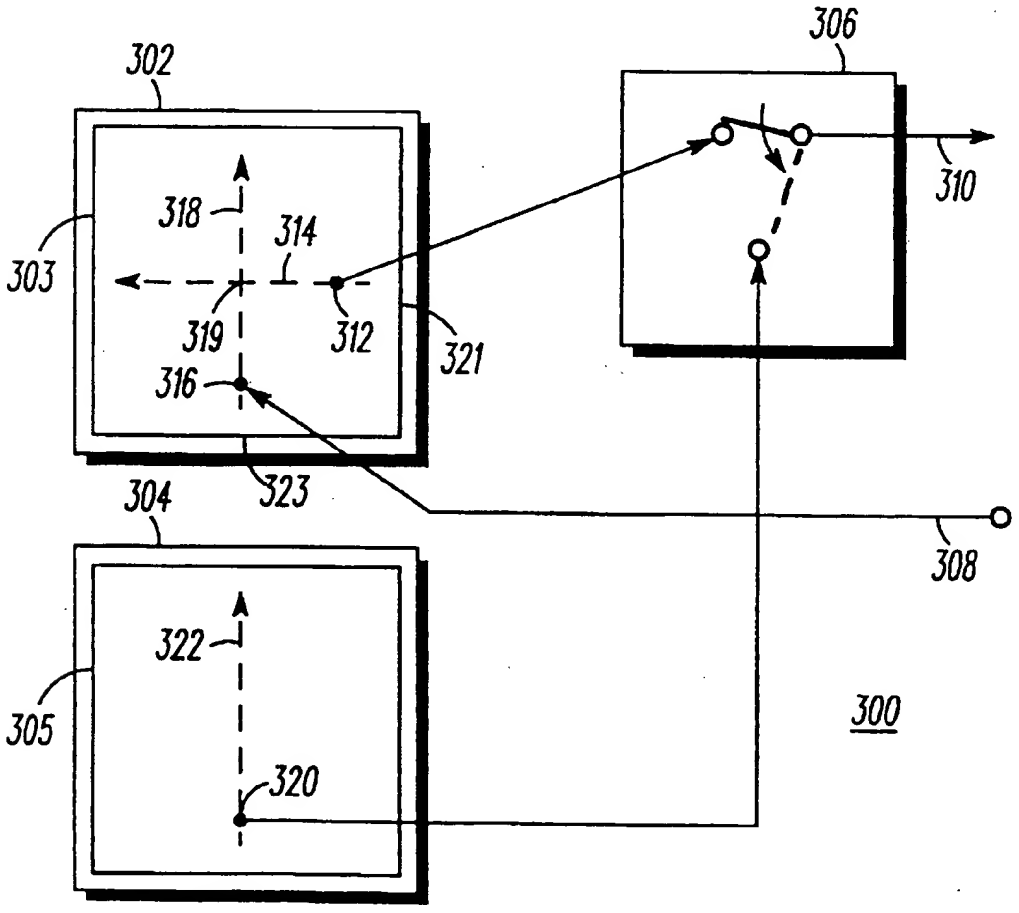
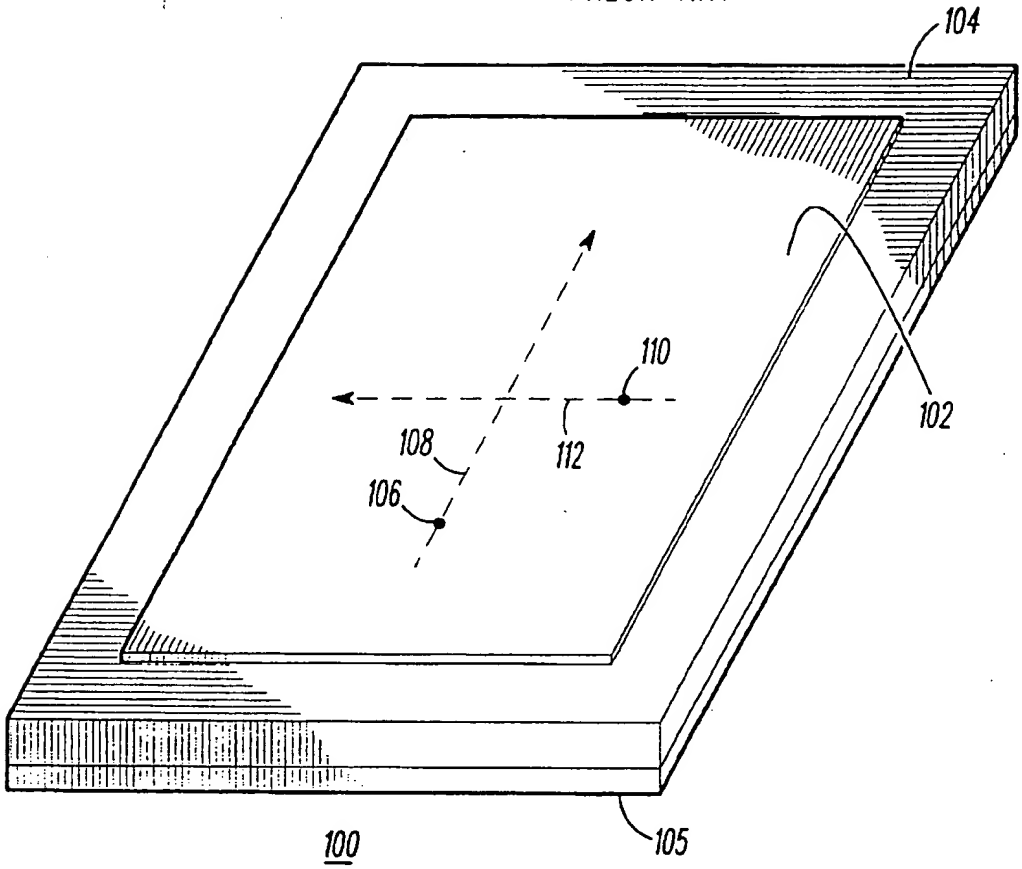


FIG.1
—PRIOR ART—



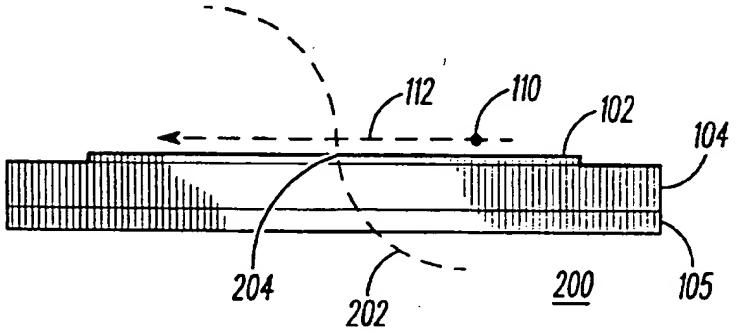


FIG.2
—PRIOR ART—

FIG. 3

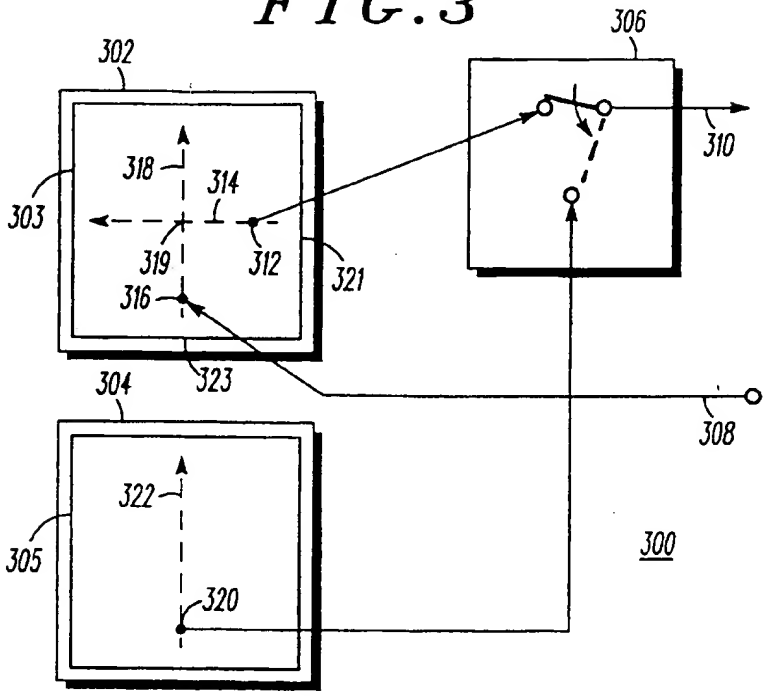
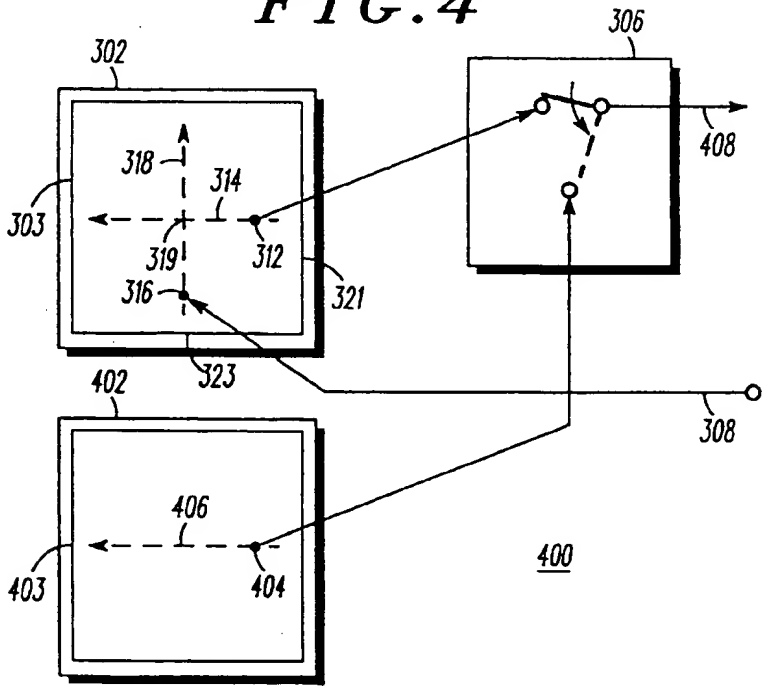
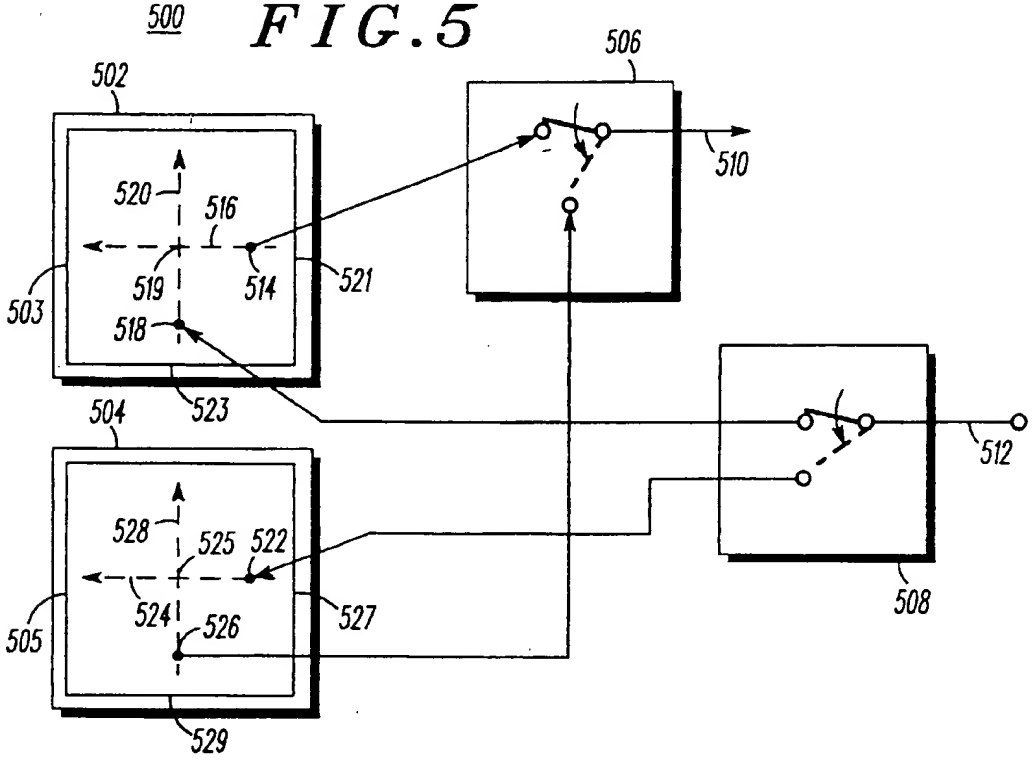

302
306
310
318
314
303
319
312
321
316
323
304
308
322
305
320
300

FIG. 4


306
302
408
318
314
303
319
312
321
316
323
402
308
406
400
403
404

500

FIG. 5



600

FIG. 6

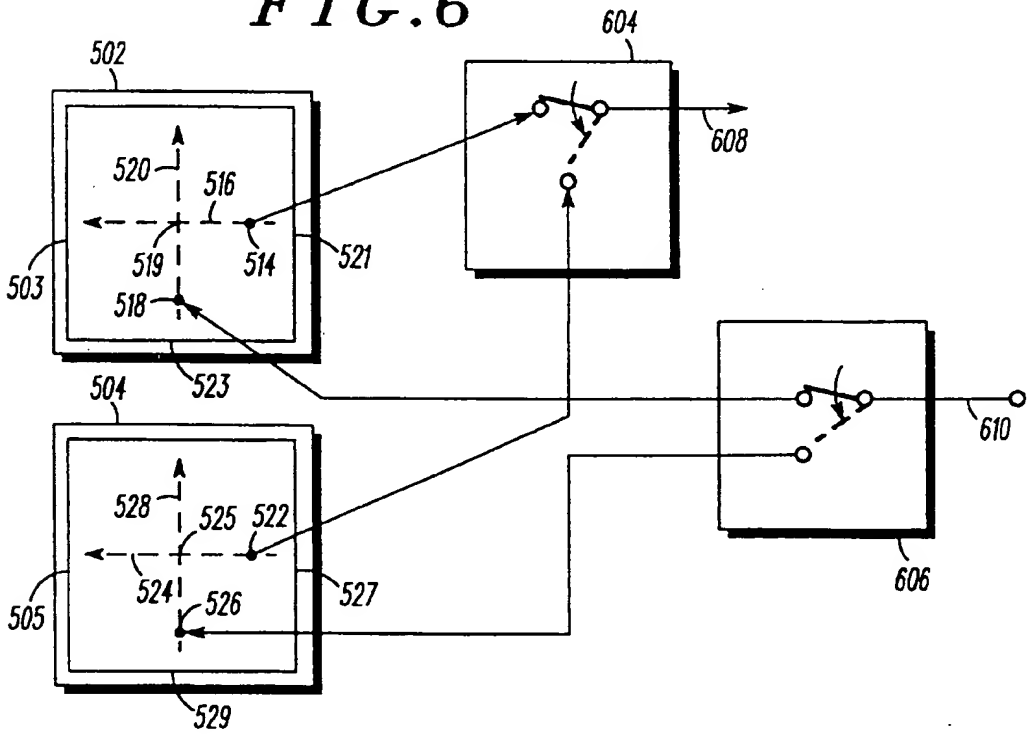


FIG.7

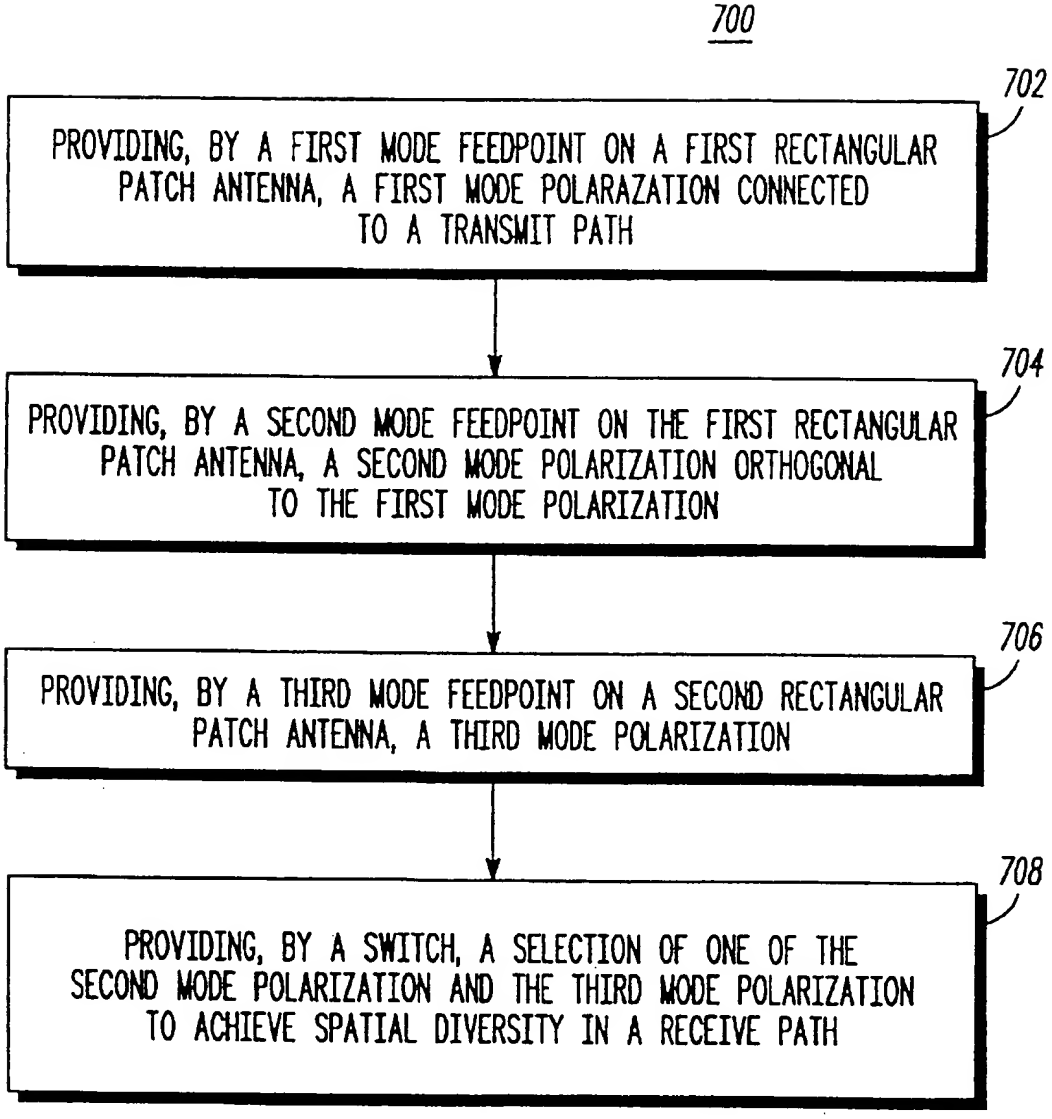

700
702
PROVIDING, BY A FIRST MODE FEEDPOINT ON A FIRST RECTANGULAR PATCH ANTENNA, A FIRST MODE POLARAZATION CONNECTED TO A TRANSMIT PATH
704
PROVIDING, BY A SECOND MODE FEEDPOINT ON THE FIRST RECTANGULAR PATCH ANTENNA, A SECOND MODE POLARIZATION ORTHOGONAL TO THE FIRST MODE POLARIZATION
706
PROVIDING, BY A THIRD MODE FEEDPOINT ON A SECOND RECTANGULAR PATCH ANTENNA, A THIRD MODE POLARIZATION
708
PROVIDING, BY A SWITCH, A SELECTION OF ONE OF THE SECOND MODE POLARIZATION AND THE THIRD MODE POLARIZATION TO ACHIEVE SPATIAL DIVERSITY IN A RECEIVE PATH

FIG. 8

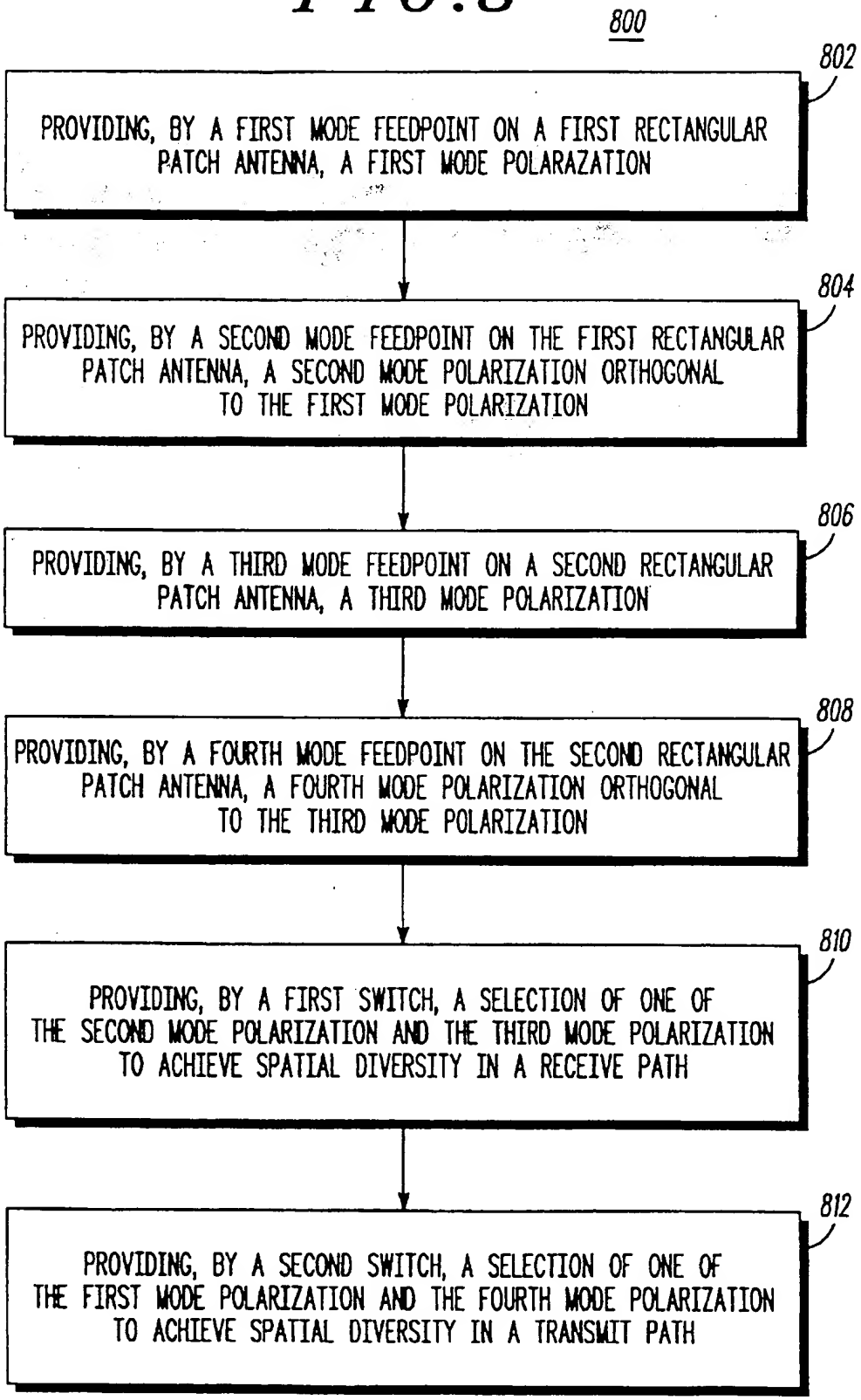
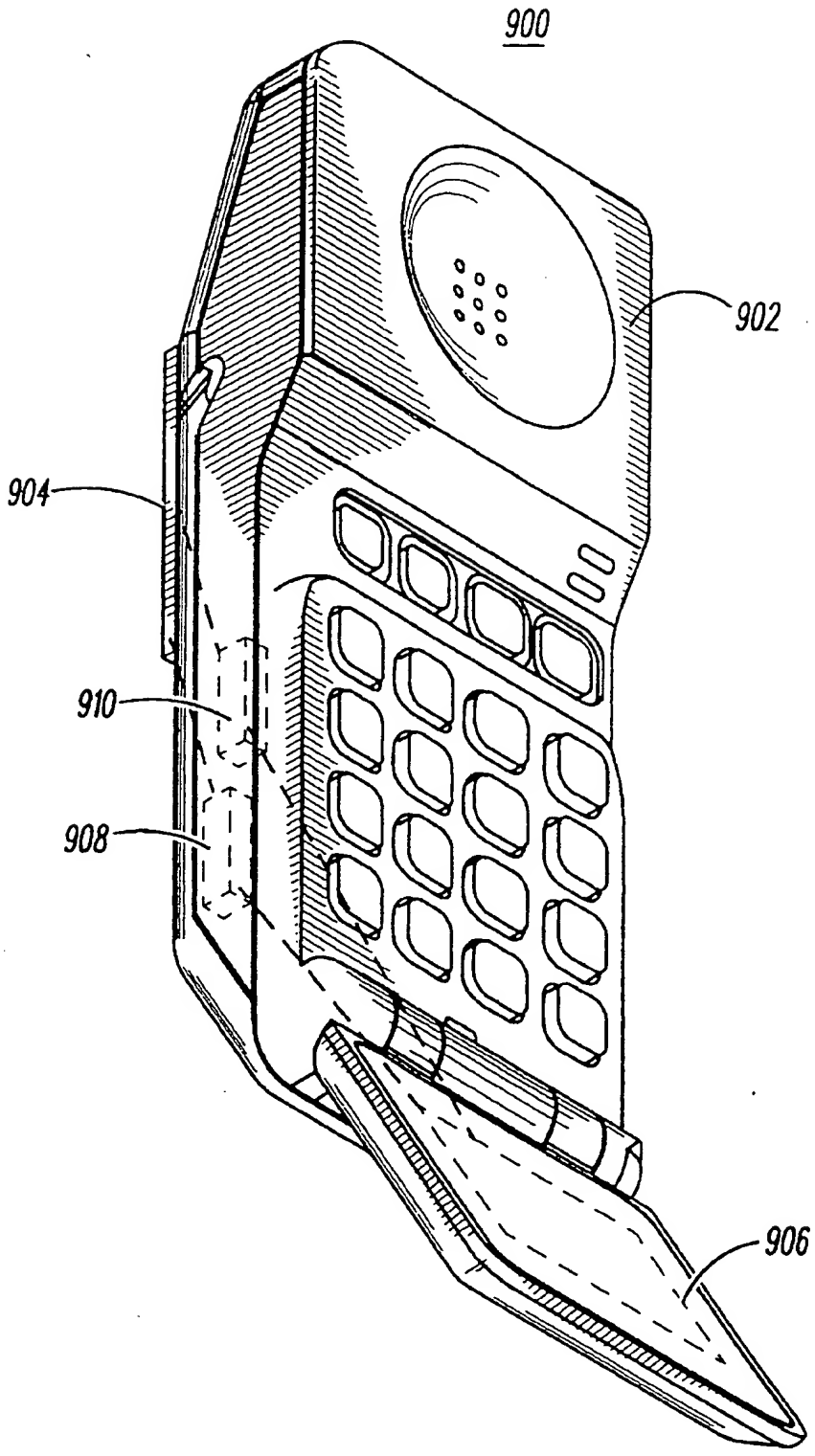

800
802
PROVIDING, BY A FIRST MODE FEEDPOINT ON A FIRST RECTANGULAR PATCH ANTENNA, A FIRST MODE POLARAZATION
804
PROVIDING, BY A SECOND MODE FEEDPOINT ON THE FIRST RECTANGULAR PATCH ANTENNA, A SECOND MODE POLARIZATION ORTHOGONAL TO THE FIRST MODE POLARIZATION
806
PROVIDING, BY A THIRD MODE FEEDPOINT ON A SECOND RECTANGULAR PATCH ANTENNA, A THIRD MODE POLARIZATION
808
PROVIDING, BY A FOURTH MODE FEEDPOINT ON THE SECOND RECTANGULAR PATCH ANTENNA, A FOURTH MODE POLARIZATION ORTHOGONAL TO THE THIRD MODE POLARIZATION
810
PROVIDING, BY A FIRST SWITCH, A SELECTION OF ONE OF THE SECOND MODE POLARIZATION AND THE THIRD MODE POLARIZATION TO ACHIEVE SPATIAL DIVERSITY IN A RECEIVE PATH
812
PROVIDING, BY A SECOND SWITCH, A SELECTION OF ONE OF THE FIRST MODE POLARIZATION AND THE FOURTH MODE POLARIZATION TO ACHIEVE SPATIAL DIVERSITY IN A TRANSMIT PATH

FIG. 9



METHOD, DUAL RECTANGULAR PATCH ANTENNA SYSTEM AND RADIO FOR PROVIDING ISOLATION AND DIVERSITY

FIELD OF THE INVENTION

The present invention relates generally to antenna systems, and more particularly to patch antenna systems with diversity.

BACKGROUND OF THE INVENTION

In microwave communications, the strength of a microwave signal can decrease as a result of communication channel impairments due to natural causes such as precipitation, humidity, or terrain and man-made causes such as structures which scatter or block the microwave signal. In some situations the decrease in signal strength prevents reliable communication. Diversity provides multiple opportunities to access the microwave signal and improve the probability of reliable communication. The multiple opportunities to access the microwave signal may be implemented by exploiting redundancies in the time, frequency and/or field domains of the signal, where field domains consist of the spatial, polarization, and radiation pattern attributes of the signal.

A single dual-mode patch antenna, which is a microstrip antenna excited to generate two orthogonal polarizations, has been used for diversity in Motorola's 2.45 GHz radio local area network, RLAN. The use of a single-mode patch or similar antennas known in the art such as an inverted-F antenna together with a whip antenna is common practice for obtaining field diversity on portable radio handsets, especially in the Japanese cellular arena.

Some emerging 1.9 GHz personal communication systems, PCSs, such as the Personal Access Communications System, PACS, air interface require that the subscriber unit provide field diversity for both transmit and receive. Typical full-duplex radios with this requirement would employ an antenna switch to select from one of the two antennas providing the field diversity and a diplexer that operates to reduce the coupled energy from the transmitter to the receiver. In a two frequency full-duplex system, diplexing allows a transmitter signal and a receiver signal to be coupled in a manner that does not degrade either signal. With knowledge of the filter impedance characteristics, controlled length transmission lines are used to provide the proper impedance for both transmitter and receiver filters. This impedance isolation is necessary for efficient operation. The filters provide signal isolation by reducing the amount of receiver signal lost to the transmitter and the amount of transmitter signal lost to the receiver. This diplexing operation imposes constraints on the circuit board layout and adds complexity to the transmit and receive filter designs, generally leading to increased insertion loss and the requirement for controlled-phase-length transmission lines between the filters. Time-duplexed systems could replace the diplexer with a second switch to select transmit or receive, but this adds an additional insertion loss to both the transmit and receive paths.

Accordingly, there is a need for a method, dual rectangular patch antenna system, and radio for providing isolation and diversity while eliminating the need for a diplexer or a second transmit/receive switch.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a prior art diagram of a dual-mode patch antenna with two feedpoints.

FIG. 2 is a prior art diagram of a voltage distribution along the second mode polarization in the batch antenna of FIG. 1.

FIG. 3 is a diagram of one embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention.

FIG. 4 is a diagram of a second embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention.

FIG. 5 is a diagram of a third embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention.

FIG. 6 is a diagram of a fourth embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention.

FIG. 7 is a flow diagram of one embodiment of a method for providing isolation and diversity in accordance with the present invention.

FIG. 8 is a flow diagram of a second embodiment of a method for providing isolation and diversity in accordance with the present invention.

FIG. 9 is a diagram of a preferred embodiment of a radio having a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Generally, the present invention provides a method, dual rectangular patch antenna system, and radio for providing isolation and diversity while eliminating the need for a diplexer or a second transmit/receive switch.

FIG. 1, numeral 100, is a prior art diagram of a dual-mode patch antenna with two feedpoints. The location of the feedpoint is critical since it directly affects the antenna's polarization and impedance. A feedpoint is typically a connection of a center conductor of a coaxial cable to a conducting layer and a connection of a shield of the coaxial cable to a ground plane, with the coaxial cable continuing away from the patch beneath the ground plane. A patch (102) in the patch antenna (100) is the conducting layer to which the center conductor is connected, and the ground plane (105) is the second conducting layer. The dielectric (104) is a nonconducting material layer, which may be air or some ceramic or fiber/resin composite, between the patch (102) and the ground plane (105). A first mode feedpoint (106) provides a first mode polarization (108), and a second mode feedpoint (110) provides a second mode polarization (112) orthogonal to the first mode polarization (108). The arrowed lines denoting modes' polarizations in FIGS. 1 through 6 show the polarization of the relevant mode's radiated electric field in the far-field zone along a central axis perpendicular to the plane of the patch conductor.

FIG. 2, numeral 200, is a prior art diagram of a voltage distribution (202) along the second mode polarization in the patch antenna of FIG. 1. In the present invention, the patch antenna (100) takes advantage of an isolation between the first mode feedpoint (106) and the second mode feedpoint (110) to serve as a diplexing connection of transmit and receive filters in a radio frequency front end of a radio. In practice, greater than 30 dB of isolation can be provided between the feedpoints (106 and 110) across a given bandwidth centered on the operating frequency, due to the existence of a voltage null (204) in each mode's voltage distribution in the middle of the patch along a line perpen-

dicular to that mode's polarization. This would allow direct connection of the filters to the antenna without requiring controlled phase length transmission lines between the filters to provide the necessary loading. The narrow bandwidth problem typically associated with a microstrip patch may be overcome by tailoring the dimensions of the patch to be resonant at the center frequency of the receive band for the receive polarization and resonant at the center frequency of the transmit band for the transmit polarization. Since the transmit and receive filters no longer need to be diplexed, the patch isolation could also allow for lower order filters, which would increase the sensitivity of the receive path and the efficiency of the transmit path. Because a patch antenna can be fabricated using printed circuit board techniques, the isolation between second mode and first mode polarizations of the patch antenna is not only very high, but also very tightly controlled and predictable. The isolation bandwidth typically exceeds the impedance bandwidth of the antenna.

Typical dimensions for a 2.45 GHz copper patch are 36 mm×36 mm, on a typical dielectric of a 3 mm thick glass/Teflon layer having a dielectric constant of 2.55.

FIG. 3, numeral 300, is a diagram of one embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention, and FIG. 4, numeral 400, is a diagram of a second embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention. Both systems (300 and 400) provide diversity for receive only and comprise a first rectangular patch antenna (302), a second rectangular patch antenna (304 and 402), and a switch (306). The difference between the systems (300 and 400) is in the second rectangular patch antenna (304 and 402).

The first rectangular patch antenna (302) has a top layer that is a substantially planar conductive rectangular first patch (303) with four coplanar sides, a first midline, and a second midline. The first midline is orthogonal to a first side of the first patch, and the second midline is parallel to the first side of the first patch and intersects the first midline at a center of the first patch. The first patch (303) comprises a first mode feedpoint (316) for providing a first mode polarization (318) for a transmit path (308) and a second mode feedpoint (312) for providing a second mode polarization (314) for a receive path, which is orthogonal to the first mode polarization (318). The first mode feedpoint (316) and the second mode feedpoint (312) are located such that an isolation is provided by a voltage null of the first mode polarization along the second midline and a voltage null of the second mode polarization along the first midline. The first mode feedpoint (316) is located on the first midline between the first side (323) and the center (319) of the first patch, and the second mode feedpoint (312) is located on the second midline between a second side (321) and the center (319) of the first patch. The first side (323) is adjacent and orthogonal to the second side (321).

In FIG. 3 the second rectangular patch antenna (304) is spatially separated from the first rectangular patch antenna (302) and has a top layer that is a substantially planar conductive rectangular second patch (305). The second patch (305) comprises a third mode feedpoint (320) for providing a third mode polarization (322) for the receive path (310). The third mode polarization (322) is orthogonal to the second mode polarization (314). This arrangement provides polarization as well as space diversity in the receive path (310). The transmit path (308) is devoid of switches and diplex circuits reducing insertion loss by increasing the radiated power for a given transmitter output. In a time-duplexed system, transmit-to-receive isolation is optimized by setting the antenna switch to select the first rectangular patch antenna (302) during transmit operation.

The preferred embodiment for transmit-to-receive isolation in a full-duplex system is depicted in FIG. 4. The second rectangular patch antenna (402) is spatially separated from the first rectangular patch antenna (302) and has a top layer that is a substantially planar conductive rectangular second patch (403). The second patch (403) comprises a third mode feedpoint (404) providing a third mode polarization (406) orthogonal to the first mode polarization (318). The third mode feedpoint (404) is connected to the switch (306) for diversity. While spatial diversity is maintained in the receive path (408), the benefit of polarization diversity is not.

The switch (306) is operably coupled to select one of the second mode feedpoint of the first rectangular patch antenna and the third mode feedpoint of the second rectangular patch antenna. The selection is made based on a predetermined signal quality. Well known diversity algorithms may use received signal strength indication, RSSI, to determine the best antenna to use. The switch (306) provides spatial diversity in the receive path. The RF switch (306) can be implemented using PIN diode circuits or GaAs FET switching circuits as is well known in the art.

FIG. 5, numeral 500, is a diagram of a third embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention. FIG. 6, numeral 600, is a diagram of a fourth embodiment of a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention. Both systems comprise a first rectangular patch antenna (502), a second rectangular patch antenna (504), a first switch (506 and 604), and a second switch (508 and 606). The difference between the systems shown in FIG. 5 and FIG. 6 is the connection scheme for the first and second switches (506, 604, 508, and 606).

The first rectangular patch antenna (502) has a top layer that is a substantially planar conductive rectangular first patch (503) with four coplanar sides, a first midline, and a second midline. The first midline is orthogonal to a first side (523) of the first patch (503), and the second midline is parallel to the first side (523) of the first patch (503) and intersects the first midline at a center (519) of the first patch (503). The first patch (503) comprises a first mode feedpoint (518) for providing a first mode polarization (520) and a second mode feedpoint (514) for providing a second mode polarization (516) orthogonal to the first mode polarization (520). The first mode feedpoint (518) and the second mode feedpoint (514) are located such that an isolation is provided by a voltage null of the first mode polarization (520) along the second midline and a voltage null of the second mode polarization along the first midline. The first mode feedpoint (518) is located on the first midline between the first side (523) and the center (519) of the first patch, and the second mode feedpoint (514) is located on the second midline between a second side (521) and the center (519) of the first patch (503). The first side (523) is adjacent and orthogonal to the second side (521).

The second rectangular patch antenna (504) is spatially separated from the first rectangular patch antenna (502) and has a top layer that is a substantially planar conductive rectangular second patch (505) with four coplanar sides, a third midline, and a fourth midline. The third midline is orthogonal to a first side (529) of the second patch (505), and the second midline is parallel to the first side (529) of the second patch and intersects the first midline at a center (525)

of the second patch. The second patch (505) comprises a third mode feedpoint (526) for providing a third mode polarization (528) and a fourth mode feedpoint (522) for providing a fourth mode polarization (524) orthogonal to the third mode polarization (528). The third mode feedpoint (526) and the fourth mode feedpoint (522) are located such that an isolation is provided by a voltage null of the third mode polarization (528) along the fourth midline and a voltage null of the second mode polarization along the third midline. The third mode feedpoint (526) is located on the first midline between the first side (529) and the center (525) of the second patch, and the fourth mode feedpoint (522) is located on the fourth midline between a second side (527) and the center (525) of the second patch (505). The first side (529) is adjacent and orthogonal to the second side (527).

In FIG. 5, the first switch (506) is operably coupled to select one of the second mode feedpoint (514) of the first rectangular patch antenna (502) and the third mode feedpoint (526) of the second rectangular patch antenna (504) for providing spatial diversity and polarization diversity in the receive path (510). The second switch (508) is operably coupled to select one of the first mode feedpoint (518) of the first rectangular patch antenna (502) and the fourth mode feedpoint (522) of the second rectangular patch antenna (504) for providing spatial diversity and polarization diversity in the transmit path (512).

In FIG. 6, the first switch (604) is operably coupled to select one of the second mode feedpoint (514) of the first rectangular patch antenna (502) and the fourth mode feedpoint (522) of the second rectangular patch antenna (504) for providing spatial diversity in the receive path (608). The second switch (606) is operably coupled to select one of the first mode feedpoint (518) of the first rectangular patch antenna (502) and the third mode feedpoint (526) of the second rectangular patch antenna (504) for providing spatial diversity in the transmit path (610). This arrangement is advantageous for applications where the first rectangular patch antenna and the second rectangular patch antenna do not lie on the same plane since pattern diversity is provided.

The selection made by the switches is based on one or more predetermined signal qualities. Well known diversity algorithms may use received signal strength indication, RSSI, to determine the best antenna to use.

FIG. 7, numeral 700, is a flow diagram of one embodiment of a method for providing isolation and diversity in accordance with the present invention. The first step is providing, by a first mode feedpoint on a first rectangular patch antenna, a first mode polarization (702). The second step is providing, by a second mode feedpoint on a first rectangular patch antenna, a second mode polarization orthogonal to the first mode polarization (704). The first mode feedpoint and the second mode feedpoint are located such that an isolation is provided by a voltage null of the first mode polarization in the middle of the first rectangular patch antenna along a line perpendicular to the first mode polarization and a voltage null of the second mode polarization in the middle of the first rectangular patch antenna along a line perpendicular to the second mode polarization. The third step is providing, by a third mode feedpoint on a second rectangular patch antenna, a third mode polarization, wherein the second rectangular patch antenna is spatially separated from the first rectangular patch antenna (706). The fourth step is providing, by a switch, a selection of either the second mode polarization or the third mode polarization to provide spatial diversity in the receive path (708).

The third mode polarization may be orthogonal to the first mode polarization to provide signal isolation in the receive path in a full-duplex system. Alternatively, the third mode polarization may be orthogonal to the second mode polarization to provide polarization diversity in the receive path. The selection of either the second mode polarization or the third mode polarization is made based on a predetermined signal quality. Well known diversity algorithms may use received signal strength indication, RSSI, to determine the best antenna to use.

FIG. 8, numeral 800, is a flow diagram of a second embodiment of a method for providing isolation and diversity in accordance with the present invention. The first step is providing, by a first mode feedpoint on a first rectangular patch antenna, a first mode polarization (802). The second step is providing, by a second mode feedpoint on a first rectangular patch antenna, a second mode polarization orthogonal to the first mode polarization (804). The first mode feedpoint and the second mode feedpoint are located such that an isolation is provided by a voltage null of the first mode polarization in the middle of the first rectangular patch antenna along a line perpendicular to the first mode polarization and a voltage null of the second mode polarization in the middle of the first rectangular patch antenna along a line perpendicular to the second mode polarization. The third step is providing, by a third mode feedpoint on a second rectangular patch antenna, a third mode polarization (806). The fourth step is providing, by a fourth mode feedpoint on a second rectangular patch antenna, a fourth mode polarization orthogonal to the third mode polarization (808). The third mode feedpoint and the fourth mode feedpoint are located such that an isolation is provided by a voltage null of the third mode polarization in the middle of the second rectangular patch antenna along a line perpendicular to the third mode polarization and a voltage null of the fourth mode polarization in the middle of the second rectangular patch antenna along a line perpendicular to the fourth mode polarization. The fifth step is providing, by a first switch, a selection between one of the second mode feedpoint of the first rectangular patch antenna and the third mode feedpoint of the second rectangular patch antenna to provide spatial diversity in the receive path (810). The sixth step is providing, by a second switch, a selection of either the first mode polarization or the fourth mode polarization to provide spatial diversity in the transmit path (812).

The selection of either the second mode polarization or the third mode polarization is made based on a first predetermined signal quality. The selection of either the first mode polarization or the fourth mode polarization is made based on a second predetermined signal quality which may or may not be the same as the first predetermined signal quality. Well known diversity algorithms may use received signal strength indication, RSSI, to determine the best antenna to use.

FIG. 9, numeral 900, is a diagram of a preferred embodiment of a radio having a dual rectangular patch antenna system for providing isolation and diversity in accordance with the present invention. Two physically separated patch antennas (904 and 906) can be connected to switches (908 and 910) and mounted on a radio handset (902). The radio (902) can transmit and receive on either antenna (904 and 906) simultaneously while incurring only one switch loss, that being the loss of the switch in both the transmit and receive paths that directs the transmitted and received signal to the desired antenna. Typical arrangements have a switch to select the antenna and another switch to select transmit or receive. With one less switch in the path, the radio (902) exhibits a higher receiver sensitivity as well as a higher radiated power for a given transmitter amplifier output,

while allowing for simultaneous transmit and receive. One patch antenna (904) may be mounted on the back of the handset located such that it is not obscured by the hand of the operator, while the second patch antenna (906) may be placed in a flip portion at the radio's base. This arrangement provides a degree of space, pattern, and polarization diversity.

In applications that require only receive diversity, this invention allows the elimination of all switches or diplexer connections from the transmit path, thus maximizing radiated power for a given transmitter amplifier output. This is important for controlling cost and current drain in microwave applications such as RLANs, since a lossy transmit path increases the power requirement of the transmitter amplifier for a given effective radiated power.

Although exemplary embodiments are described above, it will be obvious to those skilled in the art that many alterations and modifications may be made without departing from the invention. For example, the feedpoint that has been described is a probe feed, but those skilled in the art will recognize that any possible alternative feed structure, such as an aperture feed, microstrip conductive feed, or electromagnetic field proximity feed may also be employed to couple energy to and from the antenna. Similarly, any antenna structure that exhibits isolation and field diversity, such as crossed dipoles, crossed inverted-F or crossed slots/apertures, or antennas that implement combinations of left hand/right hand elliptical polarization, may serve as the radiating structure. It is acknowledged that design tradeoffs can be made with modified probe locations that alter achievable isolation. Accordingly, it is intended that all such alterations and modifications be included within the spirit and scope of the invention as defined in the appended claims.

We claim:

1. A dual rectangular patch antenna system for providing isolation and diversity comprising:

A) a first rectangular patch antenna having a substantially planar conductive rectangular first patch with four coplanar sides, a first midline orthogonal to a first side, and a second midline parallel to the first side and intersecting the first midline at a center of the first patch, wherein the first patch includes:

Aa1) a first mode feedpoint, located on the first midline between the first side and the center of the first patch, for providing a first mode polarization, wherein the first mode feedpoint is connected to a transmit path; and

A2) a second mode feedpoint, located on the second midline between a second side, adjacent to the first side, and the center of the first patch, for providing a second mode polarization orthogonal to the first mode polarization, wherein the first mode feedpoint and the second mode feedpoint are located such that an isolation is provided by a voltage null of the first mode polarization along the second midline and a voltage null of the second mode polarization along the first midline;

B) a second rectangular patch antenna, spatially separated from the first rectangular patch antenna, having a substantially planar conductive rectangular second patch including a third mode feedpoint for providing a third mode polarization; and

C) a switch, operably coupled to select one of the second mode feedpoint of the first rectangular patch antenna and the third mode feedpoint of the second rectangular patch antenna based on a predetermined signal quality, for providing spatial diversity in a receive path.

2. The dual rectangular patch antenna system of claim 1, wherein the third mode polarization is orthogonal to the first mode polarization to provide signal isolation between a transmit and a receive path in a full-duplex system.

3. The dual rectangular patch antenna system of claim 1, wherein the third mode polarization is orthogonal to the second mode polarization to provide polarization diversity in the receive path.

4. The dual rectangular patch antenna system of claim 1, wherein the second patch has four coplanar sides, a third midline orthogonal to a first side of the second patch, and a fourth midline parallel to the first side of the second patch and intersecting the third midline at a center of the second patch, the second patch includes:

B1) the third mode feedpoint, located on the third midline between the first side of the second patch and the center of the second patch, for providing a third mode polarization; and

B2) a fourth mode feedpoint, located on the fourth midline between a second side, adjacent to the first side, of the second patch and the center of the second patch, for providing a fourth mode polarization orthogonal to the third mode polarization, wherein the third mode feedpoint and the fourth mode feedpoint are located such that an isolation is provided by a voltage null of the third mode polarization along the fourth midline and a voltage null of the fourth mode polarization along the third midline.

5. The dual rectangular patch antenna system of claim 4, wherein the system further comprises a second switch, operably coupled to select one of the first mode feedpoint of the first rectangular patch antenna and the fourth mode feedpoint of the second rectangular patch antenna based on a second predetermined signal quality, for providing spatial diversity in the transmit path.

6. A method for providing isolation and diversity comprising:

A) providing, by a first feed point on a first rectangular patch antenna, a first mode polarization connected to a transmit path;

B) providing, by a second feedpoint on the first rectangular patch antenna, a second mode polarization orthogonal to the first mode polarization and isolated from the first mode polarization;

C) providing, by a third feedpoint on a second rectangular patch antenna, a third mode polarization, wherein in the second rectangular patch antenna is spatially separated from the first rectangular patch antenna; and

D) providing, by a switch, a selection of one of the second mode polarization and the third mode polarization based on a predetermined signal quality to provide spatial diversity in a receive path.

7. The method of claim 6, wherein the third mode polarization is orthogonal to the first mode polarization to provide signal isolation between the transmit path and the receive path in a full-duplex system.

8. The method of claim 6, wherein the third mode polarization is orthogonal to the second mode polarization to provide polarization diversity in the receive path.

9. The method of claim 6, wherein the method further comprises:

E) providing, by a fourth feedpoint on the second rectangular patch antenna, a fourth mode polarization orthogonal to the third mode polarization and isolated from the third mode polarization; and

F) providing, by a second switch, a selection of one of the first mode polarization and the fourth mode polarization based on a second predetermined signal quality to provide spatial diversity in the transmit path.

10. A dual rectangular patch antenna system for providing isolation and diversity comprising:

A) a first rectangular patch antenna having a substantially planar conductive rectangular first patch with four coplanar sides, a first midline orthogonal to a first side, and a second midline parallel to the first side and intersecting the first midline at a center of the first patch, wherein the first patch includes:

A1) a first mode feedpoint, located on the first midline between the first side and the center of the first patch, for providing a first mode polarization, wherein the first mode feedpoint is connected to a transmit path; and

A2) a second mode feedpoint, located on the second midline between a second side, adjacent to the first side, and the center of the first patch, for providing a second mode polarization orthogonal to the first mode polarization, wherein the first mode feedpoint and the second mode feedpoint are located such that an isolation is provided by a voltage null of the first mode polarization along the second midline and a voltage null of the second mode polarization along the first midline;

B) a second rectangular patch antenna, spatially separated from the first rectangular patch antenna, having a substantially planar conductive rectangular second patch with four coplanar sides, a third midline orthogonal to a first side of the second patch, and a fourth midline parallel to the first side of the second patch and intersecting the third midline at a center of the second patch, wherein the second patch includes:

B1) the third mode feedpoint, located on the third midline between the first side of the second patch and the center of the second patch, for providing a third mode polarization; and

B2) a fourth mode feedpoint, located on the fourth midline between a second side, adjacent to the first side, of the second patch and the center of the second patch, for providing a fourth mode polarization orthogonal to the third mode polarization, wherein the third mode feedpoint and the fourth mode feedpoint are located such that an isolation is provided by a voltage null of the third mode polarization along the fourth midline and a voltage null of the fourth mode polarization along the third midline;

C) a first switch, operably coupled to select one of the second mode feedpoint of the first rectangular patch antenna and the third mode feedpoint of the second rectangular patch antenna based on a predetermined signal quality, for providing spatial diversity in a receive path; and

D) a second switch, operably coupled to select one of the first mode feedpoint of the first rectangular patch antenna and the fourth mode feedpoint of the second rectangular patch antenna based on a second predetermined signal quality, for providing spatial diversity in the transmit path.

11. The dual rectangular patch antenna system of claim 10, wherein the second mode polarization is orthogonal to the third mode polarization to provide polarization diversity in the receive path.

12. The dual rectangular patch antenna system of claim 10, wherein the first mode polarization is orthogonal to the fourth mode polarization to provide polarization diversity in the transmit path.

13. A method for providing isolation and diversity comprising:

A) providing, by a first feedpoint on a first rectangular patch antenna, a first mode polarization connected to a transmit path;

B) providing, by a second feedpoint on the first rectangular patch antenna, a second mode polarization orthogonal to the first mode polarization and isolated from the first mode polarization;

C) providing, by a third feedpoint on a second rectangular patch antenna, a third mode polarization, wherein in the second rectangular patch antenna is spatially separated from the first rectangular patch antenna; and

D) providing, by a fourth feedpoint on the second rectangular patch antenna, a fourth mode polarization orthogonal to the third mode polarization and isolated from the third mode polarization;

E) providing, by a first switch, a selection of one of the second mode polarization and the third mode polarization based on a predetermined signal quality to provide spatial diversity in a receive path; and

F) providing, by a second switch, a selection of one of the first mode polarization and the fourth mode polarization based on a second predetermined signal quality to provide spatial diversity in the transmit path.

14. The method of claim 13, wherein the second mode polarization is orthogonal to the third mode polarization to provide polarization diversity in the receive path.

15. The method of claim 13, wherein the first mode polarization is orthogonal to the fourth mode polarization to provide polarization diversity in the transmit path.

16. A radio having a dual rectangular patch antenna system for providing isolation and diversity, the dual rectangular patch antenna system comprising:

A) a first rectangular patch antenna having a substantially planar conductive rectangular first patch with four coplanar sides, a first midline orthogonal to a first side, and a second midline parallel to the first side and intersecting the first midline at a center of the first patch, wherein the first patch includes:

A1) a first mode feedpoint, located on the first midline between the first side and the center of the first patch, for providing a first mode polarization, wherein the first mode feedpoint is connected to a transmit path; and

A2) a second mode feedpoint, located on the second midline between a second side, adjacent to the first side, and the center of the first patch, for providing a second mode polarization orthogonal to the first mode polarization, wherein the first mode feedpoint and the second mode feedpoint are located such that an isolation is provided by a voltage null of the first mode polarization along the second midline and a voltage null of the second mode polarization along the first midline;

B) a second rectangular patch antenna, spatially separated from the first rectangular patch antenna, having a substantially planar conductive rectangular second patch with four coplanar sides, a third midline orthogonal to a first side of the second patch, and a fourth midline parallel to the first side of the second patch and intersecting the third midline at a center of the second patch, wherein the second patch includes:

B1) the third mode feedpoint, located on the third midline between the first side of the second patch

and the center of the second patch, for providing a third mode polarization; and

B2) a fourth mode feedpoint, located on the fourth midline between a second side, adjacent to the first side, of the second patch and the center of the second patch, for providing a fourth mode polarization orthogonal to the third mode polarization, wherein the third mode feedpoint and the fourth mode feedpoint are located such that an isolation is provided by a voltage null of the third mode polarization along the fourth midline and a voltage null of the fourth mode polarization along the third midline;

C) a first switch, operably coupled to select one of the second mode feedpoint of the first rectangular patch antenna and the third mode feedpoint of the second rectangular patch antenna based on a predetermined signal quality, for providing spatial diversity in a receive path; and

D) a second switch, operably coupled to select one of the first mode feedpoint of the first rectangular patch antenna and the fourth mode feedpoint of the second rectangular patch antenna based on a second predetermined signal quality, for providing spatial diversity in the transmit path.

* * * * *

APPENDIX 3

Case Law Relied Upon in Applicants' Brief

VIII.

For the foregoing reasons, the judgment of the district court's is affirmed with respect to Plaintiff Lone Star Steakhouse and reversed and remanded with respect to Plaintiff Max Shayne.

AFFIRMED IN PART; REVERSED AND REMANDED IN PART

U.S. Court of Appeals
Federal Circuit

Glaverbel Société Anonyme v. Northlake Marketing & Supply Inc.

Nos. 92-1316, -1317

Decided January 23, 1995

PATENTS

1. Patentability/Validity — Anticipation — Identity of elements (§115.0704)

Anticipation requires identity of invention, and thus requires that claimed invention, as described in appropriately construed claims, be found to be same as that of reference; federal district court did not err in determining that claims for ceramic welding process for repairing industrial furnaces were not same as prior art, based upon patent specification and expert testimony in field of invention.

2. Patentability/Validity — Obviousness — In general (§115.0901)

Patentability/Validity — Obviousness — Relevant prior art — Particular inventions (§115.0903.03)

Federal district court did not err in determining that claims for ceramic welding process for repairing industrial furnaces are not obvious, despite accused infringer's assertion that court made no explicit findings as to each obviousness factor, since accused infringer, not trial court, has burden of pointing out any aspects of obviousness inquiry that require particular attention, and since any assertion that findings were incomplete must include reasonable basis for arguing such error, which accused infringer has failed to do.

3. Infringement — Defenses — Fraud or unclean hands (§120.1111)

Patentee's citation during initial prosecution only of British prior art patent, and not its U.S. counterpart, does not establish patentee's material misrepresentation or its intent to mislead.

4. Patent misuse — Federal antitrust issues (§140.07)

Federal district court did not err in rejecting patent infringement defendant's assertion that filing of lawsuit violated Sherman Act, even though court found that defendant had not infringed, in view of evidence showing that defendant's own witnesses did not unequivocally deny infringement, and showing that plaintiff had sought to resolve issue without litigation; plaintiff's lawsuits in other countries against defendant, for violation of plaintiff's foreign patents covering same technology, also have not been shown to have been brought for purpose of harassment and in bad faith.

JUDICIAL PRACTICE AND PROCEDURE

5. Procedure — Summary judgment — Patents (§410.3303)

Exhibit which was submitted by patent infringement defendant in support of its motion for summary judgment of non-infringement, and which accompanied deposition testimony and was received for that purpose without objection, should have been considered by federal district court in ruling on summary judgment motion, since court may consider on summary judgment exhibits made part of deposition record.

6. Procedure — Summary judgment — Patents (§410.3303)

Federal district court, in ruling on patent infringement defendant's motion for partial summary judgment as to specific formulations of accused ceramic welding process, erred by granting summary judgment of non-infringement that encompassed all of defendant's formulations, whether or not they were included in motion.

Particular patents — Chemical — Ceramic welding

4,489,022, Robyn and Deschepper, and 3,684,560, ceramic welding process for repairing industrial furnaces, summary judgment of validity affirmed; summary judgment of non-infringement reversed in part, and remanded.

Appeal from the U.S. District Court for the Northern District of Indiana, Rodovich, J.

Action by Glaverbel Société Anonyme and Fosbel Inc. against Northlake Market-

ing & Supply Inc., Frank Zlamal, Samuel E. May, and Jim Hamilton, for patent infringement. From federal district court's grant of summary judgment holding that patents are valid, enforceable, and not infringed, parties cross-appeal. Judgment as to validity and enforceability affirmed; judgment as to non-infringement affirmed in part, reversed in part, and remanded.

Jerold I. Schneider, Brian M. Kolkowski, and George H. Spencer, of Spencer, Frank & Schneider, Washington, D.C., for plaintiffs.

Ronald H. Isroff, of Ulmer & Berne, Cleveland, Ohio, for plaintiff Fosbel Inc.

Anthony S. DiVincenzo, of Campbell & DiVincenzo, Chicago, Ill., and John C. Brezina, of Brezina & Buckingham, Oak Brook, Ill., for defendants.

Before Newman, Mayer, and Clevenger, circuit judges.

Newman, J.

Northlake Marketing & Supply, Inc., Frank Zlamal, Samuel E. May, and Jim Hamilton (together "Northlake") appeal the judgment of the United States District Court for the Northern District of Indiana,[1] upholding the validity of United States Patents Nos. 3,684,560 (the '560 patent) and 4,489,022 (the '022 patent), and declining to find fraudulent procurement or that the patents were used to violate the antitrust laws. Glaverbel Société Anonyme and its exclusive licensee Fosbel, Inc. (collectively "Glaverbel") cross-appeal the grant of Northlake's motion for summary judgment of non-infringement.[2] We sustain the judgment on appeal, reverse in part the summary judgment on cross-appeal, and remand for trial of the issue of infringement.

I
PATENT VALIDITY
The Patents in Suit

The '560 and '022 patents relate to a ceramic welding process for repairing industrial furnaces. Ceramic welding is described as the process of forming a coherent refractory mass on the furnace wall. In the patented process this is achieved by projecting, against the wall of the furnace, particles of an oxidizable substance that burns exothermically and a refractory substance, whereby an exothermic reaction at the surface welds the refractory mass to the wall. Claim 1 of the '560 patent, the broadest claim, is as follows:

> 1. A process of forming a refractory mass comprising the steps of:
>
> projecting against a surface particles of at least one oxidizable substance which burns by combining with oxygen with accompanying evolution of heat, said particles having an average size of less than 50 microns, and particles of at least one different substance, along with a combustion supporting gas,
>
> at least one of said substances being of a composition such that under the heat of combustion of said oxidizable substance a coherent refractory mass is formed from said oxidizable substance and the different substance;
>
> and burning the oxidizable substance substantially entirely while it is being projected against such surface for forming such refractory mass.

Claim 13 defines the "oxidizable substance" as aluminum, silicon, magnesium, or zirconium, and Claim 14 requires that the heat evolved by the burning step raise the temperature of the surface sufficiently to soften the surface.

The broadest claim of the '022 patent is as follows:

> 1. A process of forming a refractory mass comprising burning particles of exothermically oxidizable material having an average grain size of less than 50 um while mixed with particles of incombustible refractory material during projection of the mixture against a surface to form a coherent refractory mass on said surface, said oxidizable material comprises silicon and aluminum, the aluminum being present in an amount not exceeding 9% by weight of the total mixture, and wherein the aluminum and silicon are together present in an amount not exceeding 15% by weight of the total mixture.

Glaverbel describes the '022 patent as an improvement on the '560 patent, based on the use of silicon and aluminum particles in specified amount and proportions. According to Glaverbel flash- back is minimized, the completeness of the reaction is maximized, the cohesiveness of the refractory mass is improved, and the ratio of heat

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[1] *Glaverbel Société Anonyme v. Northlake Mktg. & Supply, Inc.*, No. H88-383 (N.D. Ind. March 31, 1992).

[2] *Glaverbel Société Anonyme v. Northlake Mkgt. & Supply, Inc.*, No. H88-383 (N.D. Ind. March 12, 1992) (Order).

generated to oxidizable material used is optimized. As a result, states Glaverbel, it is no longer necessary to match the composition of the refractory mass and the furnace wall in order to obtain a satisfactory ceramic weld.

Anticipation

Anticipation is a question of fact. *Shatterproof Glass Corp. v. Libbey-Owens Ford Co.*, 758 F.2d 613, 619, 225 USPQ 634, 637 (Fed. Cir.), *cert. dismissed*, 474 U.S. 976 (1985). When trial is to the court, the district court's finding with respect to anticipation is reviewed for clear error, with due regard to the burden and standard of proof. *Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1458, 221 USPQ 481, 485 (Fed. Cir. 1984).

The district court found that the '560 and '022 patents are not invalid for anticipation. Anticipation requires identity of the claimed process and a process of the prior art; the claimed process, including each step thereof, must have been described or embodied, either expressly or inherently, in a single reference. *Scripps Clinic & Research Found. v. Genentech Inc.*, 927 F.2d 1565, 1576, 18 USPQ2d 1001, 1010 (Fed. Cir. 1991); *see Standard Havens Prods., Inc. v. Gencor Indus., Inc.*, 953 F.2d 1360, 1369, 21 USPQ2d 1321, 1328 (Fed. Cir. 1991) ("Anticipation can occur when a claimed limitation is 'inherent' or otherwise implicit in the relevant reference.")

Northlake relied at trial on Swedish Patent No. 102,083 (the Swedish patent) and United States Patent No. 2,976,166 (the White patent), arguing that the claims of both of the Glaverbel patents overlap with or read on either or both of these references. The district court found that the processes described in the references are not similar to the processes of the patents in suit. Northlake argues that the '560 and '022 claims are invalid if they can be read on the prior art, even if the processes are not similar. That is, Northlake argues that the '560 and '022 claims can be interpreted so broadly that they include the prior art. Anticipation, however, requires identity of invention: the claimed invention, as described in appropriately construed claims, must be the same as that of the reference, in order to anticipate. *Continental Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 1267, 20 USPQ2d 1746, 1748 (Fed. Cir. 1991). *See also In re Spada*, 911 F.2d 705, 708, 15 USPQ2d 1655, 1657 (Fed. Cir. 1990) ("the reference must describe the applicant's claimed invention sufficiently to have placed a person of ordinary skill in the field of the invention in possession of it").

In determining whether a patented invention is anticipated, the claims are read in the context of the patent specification in which they arise and in which the invention is described. If needed to impart clarity or avoid ambiguity, the prosecution history and the prior art may also be consulted in order to ascertain whether the patentee's invention is novel or was previously known to the art. *Lindemann*, 730 F.2d at 1458, 221 USPQ at 485 ("In deciding the issue of anticipation, the trier of fact must identify the elements of the claims, determine their meaning in light of the specification and prosecution history and identify corresponding elements disclosed in the allegedly anticipating reference.") *Cf. Slimfold Mfg. Co. v. Kinkead Indus., Inc.*, 810 F.2d 1113, 1116, 1 USPQ2d 1563, 1566 (Fed. Cir. 1987) (claims are not interpreted "in a vacuum").

There was testimony that the prior art processes relate to flame-spraying, not combustion at the furnace wall. The district court found that the Swedish and the White patents describe heating the refractory material with a flame and using the flame to project the material against the wall, whereas the '560 and '022 patents require an exothermic reaction wherein oxidation or burning occurs at the surface of the wall. The district court also found that the Swedish patent relates to sintering, defined as "adherence below the melting point," whereas the claimed processes relate to welding above the melting point.

[1] Clear error has not been shown in the district court's findings concerning the prior art. It was not an incorrect methodology for the court to interpret the '560 and '022 patent claims in light of the patent specifications and the prior art and to receive the testimony of experts in the field of the invention, when comparing the patented invention with the prior art for the purpose of determining whether they were the same. *See Bischoff v. Wethered*, 76 U.S. (9 Wall.) 812, 815 (1870) ("variations, scarcely noticeable to a common reader, would be detected by an expert in the art"); *E.I. Du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1435-36, 7 USPQ2d 1129, 1133-34 (Fed. Cir.) (expert testimony on issue of novelty), *cert. denied*, 488 U.S. 986 (1988).

Northlake has not shown clear error in the finding of the district court that the claims of the '560 and '022 patents are not invalid for anticipation.

Obviousness

Northlake states that the district court neglected to conduct a full analysis of obviousness as required by *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). The obviousness of a patented invention is determined by applying the law of 35 U.S.C. §103 to findings of fact relating to the scope and content of the prior art, the differences between the claimed invention and the prior art, and the level of ordinary skill in the art. *Graham*, 383 U.S. at 17, 148 USPQ at 467. Objective evidence such as commercial success, copying, or long-felt need, is relevant, and when present must be considered. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538-39, 218 USPQ 871, 879 (Fed. Cir. 1983).

The perspective from which these findings are made, as well as the ultimate question of obviousness, is that of a person of ordinary skill in the field of invention. The district court's factual findings are reviewed for clear error, and the court's rulings of law based thereon receive plenary review. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1565-66, 1 USPQ2d 1593, 1594- 95 (Fed. Cir.), *cert. denied*, 481 U.S. 1052 (1987). Invalidity based on obviousness of a duly issued patent must be established by clear and convincing evidence. *Polaroid Corp. v. Eastman Kodak Co.*, 789 F.2d 1556, 1558, 229 USPQ 561, 562-63 (Fed. Cir.), *cert. denied*, 479 U.S. 850 (1986).

Northlake challenges the completeness of the court's findings of the facts relating to obviousness. That criticism was not raised at trial, and the district court was not asked to make additional findings under Fed. R. Civ. P. 52(b). When a party remains silent after full trial and decision and then complains about incomplete findings, the appellate tribunal should ascertain whether any absent findings not only were essential to resolution of the issue, but were not made by the trial judge. *See Consolidated Aluminum Corp. v. Foseco International Ltd.*, 910 F.2d 804, 814 n.9, 15 USPQ2d 1481, 1488 n.9 (Fed. Cir. 1990) ("Rule 52(b), Fed. R. Civ. P., provides for post-judgment motions for findings not made. Counsel should not simply ignore that rule and head off to the appellate court to seek a remand for the making of those same findings."); *Evans v. Suntreat Growers and Shippers Inc.*, 531 F.2d 568, 570 (Temp. Emer. Ct. App. 1976) (although failure of party to propose additional or alternate findings under Rule 52(b) does not prevent party from attacking on appeal an erroneous finding, party can not complain about lack of specificity in the findings); *United States v. Tosca*, 18 F.3d 1352, 1355 (6th Cir. 1994) (discussing the "general principle of appellate jurisprudence that a party desiring more particularized findings at the trial court level must request them from the trial court").

[2] In this case the district court specifically invoked the criteria of *Graham v. John Deere*, and thoroughly discussed the prior art and the differences from the Glaverbel inventions. *See Loctite Corp. v. Ultraseal Ltd.*, 781 F.2d 861, 873, 228 USPQ 90, 98 (Fed. Cir. 1985) ("we must be convinced from the opinion that the district court actually applied *Graham* and must be presented with enough express and necessarily implied findings to know the basis of the trial court's opinion"). Northlake complains that because the district court made no explicit findings on each of the *Graham* factors, remand is mandated. Glaverbel points out that Northlake presented no evidence of the level of ordinary skill in the art or concerning the alleged similarities between the prior art and the patents in suit, or argued that there were special considerations or details with respect to these factual aspects. It was not the trial judge's burden, but that of Northlake, to point out any aspects requiring particular attention. Although remand for additional findings may be warranted in appropriate circumstances, *see Icicle Seafoods, Inc. v. Worthington*, 475 U.S. 709, 714 (1986) (appellate court may remand for findings essential to proper resolution), an assertion that findings were incomplete must include a reasonable basis for arguing, in this case, that the district court may have had a clearly erroneous view of the level of ordinary skill or of the prior art, or that the testimony at trial, for example that presented by persons of skill in the field of the invention, may have misled the district court toward implied findings prejudicial to Northlake. Northlake has directed our attention to no clear error in the nature or completeness of the district court's findings of fact relevant to the issue of obviousness. The burden of proving invalidity was on Northlake. The district court's conclusion that the '560 and the '022 patents are not invalid on the ground of obviousness is sustained.

Inoperability

Northlake pled by counterclaim that the '560 and '022 patents do not comply with 35 U.S.C. §101, but did not state why. One week before trial Northlake requested leave to amend its counterclaim to raise the issue of inoperability. The district court denied the request as tardily made, and again when the request was renewed at trial.

Northlake had known for over a year of the relevant facts, as shown in its offer of proof. The Northlake argument as to inoperability was as follows: the '022 claims require that the aluminum and silicon particles be present "in an amount not exceeding 15% by weight of the total mixture," but the claims do not state a lower limit; therefore the claims can include such small amounts of aluminum and silicon that they would be insufficient to serve the intended purpose. Glaverbel responded that the '022 claims require the formation of "a coherent refractory mass," thus requiring the presence of sufficient particles to form a coherent mass. We are not persuaded that justice was denied by the district court's refusal to permit Northlake to introduce this issue on the eve of or during trial; thus we discern no abuse of discretion in the court's action. *Cf. Zenith Radio Corp. v. Hazeltine Research, Inc.*, 401 U.S. 321, 330- 31 (1971) (leave to amend was properly denied in view of substantial prejudice to opponent).

II

ISSUES OF COMPETITION AND CONDUCT

Northlake asserted that Glaverbel procured the '560 and '022 patents through fraud and/or inequitable conduct, violated the antitrust laws, and misused the patents.

Inequitable Conduct

Failure to disclose material information during the patent procurement process or the submission of material false information, with the intent to mislead or deceive the patent examiner into granting the patent, may render the patent permanently unenforceable. *Scripps v. Genentech*, 927 F.2d at 1573, 18 USPQ2d at 1008. The factual premises of materiality and intent must be proved by clear and convincing evidence. *Kingsdown Medical Consultants, Ltd. v. Hollister, Inc.*, 863 F.2d 867, 872, 9 USPQ2d 1384, 1389 (Fed. Cir. 1988), *cert. denied*, 490 U.S. 1067 (1989). The determination of the issue of inequitable conduct when these premises are established is within the district court's discretion, for materiality and intent must be weighed, and the consequences assessed, in light of all the circumstances. *Kingsdown*, 863 F.2d at 876, 9 USPQ2d at 1392. Thus the district court's ruling on the issue of inequitable conduct will be affirmed unless it was based on a clearly erroneous finding of fact or a misinterpretation or misapplication of law, or manifested a clear error of judgment. *Id.*; *Amgen, Inc. v. Chugai Pharmaceutical Co. Ltd.*, 927 F.2d 1200, 1215, 18 USPQ2d 1016, 1028 (Fed. Cir.), *cert. denied*, 112 S.Ct. 169 (1991).

Both the '560 and the '022 patents were reexamined by the Patent and Trademark Office at the request of Northlake. Northlake argues that material prior art references were known to Glaverbel during the initial prosecution of the '022 patent, but were not brought to the examiner's attention until Northlake requested reexamination. Northlake thus argues that both material withholding and culpable intent must be presumed from Glaverbel's failure to disclose these references during the initial prosecution, coupled with the reexamination examiner's initial rejection of the patent claims on the basis of these references.

For the '022 patent, Northlake criticizes Glaverbel for referring during the initial prosecution only to the British patent (GB '894) of which the '022 patent was an improve-ment, but not also referring to the United States counterpart (the '560 patent) of GB '894. We have been directed to no difference between the specifications of the GB '894 and the US '560 patents. These are essentially identical texts, one of which (GB '894) was before the United States examiner during the initial prosecution of the '022 application, and both of which (GB '894 and US '560) were before the examiner during the reexamination of the '022 patent.

[3] Northlake concedes that "GB '894 and US '560 are essentially identical, except for the claims." However, Northlake argues that because the claims as issued in US '560 were narrower than the claims in GB '894, there was inequitable conduct in the patent office because Glaverbel made a showing of improved combustion by the '022 process, whereas combustion was already claimed as complete in GB '894. The district court did not accept this argument as establishing inequitable conduct, and we discern no error in this conclusion. The claim style or content of GB '894, presumed to be in accordance with British law, is not relevant to the issue of inequitable conduct. Neither material misrepresentation nor intent to mislead was established by Glaverbel's citation of GB '894, and not also its US '560 counterpart, during the initial prosecution of the '022 application.

Northlake also asserts that Glaverbel's failure to cite the Swedish patent during the initial prosecution of the '022 application constitutes inequitable conduct. Although

the '022 patent claims were initially rejected during reexamination on the basis of the Swedish patent, the examiner withdrew the rejection and allowed the '022 claims. Glaverbel agreed that it knew about the Swedish patent at the time of the initial '022 prosecution, but denied the intent to mislead or deceive the examiner. Glaverbel's patent counsel, Dr. DeKeersmaecker, testified that in his opinion the Swedish patent related to a different process than the '022 process. Northlake must prove culpable intent by clear and convincing evidence. *Kingsdown*, 863 F.2d at 872, 9 USPQ2d at 1389. Northlake points to no evidence tending to show an intent to mislead or deceive.

For Glaverbel's '560 patent, Northlake asserted that because the Swedish patent was material and was not cited by Glaverbel during the '560 prosecution, Glaverbel committed inequitable conduct. The district court, rejecting this argument, referred to testimony that Glaverbel first learned of the Swedish patent four years after the '560 patent was issued, and was not aware of the Swedish patent during the initial examination of the '560 patent. Northlake does not mention this testimony, or the evidence disputing the materiality of the Swedish patent. Further, as we have discussed, both materiality and intent to deceive or mislead must be shown. Clear error has not been shown in the district court's findings that materiality and intent were not established.

Northlake also argues that Glaverbel's narrowing of the scope of the '560 claims on reexamination is, without more, probative of materiality during the initial examination. Reduction in claim scope during reexamination is not of itself probative of material withholding with intent to deceive, and supports no such inference. All of the evidence, including evidence tending to show good faith, must establish sufficient culpability to establish both materiality and intent. *Kingsdown*, 863 F.2d at 872, 9 USPQ2d at 1389. No adverse inference flows from a patentee's actions in adjusting its claims on reexamination, whether or not the patentee itself initiated the reexamination.

Northlake also asserts that Glaverbel committed inequitable conduct, during reexamination of the '560 patent, in its nondisclosure to the United States examiner of facts concerning prosecution of its corresponding foreign patents. Northlake states that Glaverbel did not inform the examiner of the rejection of the corresponding German and Danish applications based on the Swedish patent, and did not reveal that the arguments presented by Glaverbel to the United States examiner had been rejected by the German and Danish examiners. These points were explored at trial, the district court observing that one of Northlake's witnesses, Dr. Ehrman, testified that neither of Glaverbel's German patents (corresponding to the '560 and the '022 patents) was rejected for lack of novelty in view of the Swedish patent. Northlake does not attempt to explain this testimony of its own witness, despite its contrary representations on this appeal. We have been shown no basis for overturning the district court's findings on these points.

Northlake also states that Glaverbel's submission of chromium welding tests to the United States patent examiner constituted inequitable conduct, arguing that Glaverbel's tests using chromium to show the effect of grain sizes of over 50 microns were misleading. Before the district court there was conflicting testimony concerning the meaning of the tests. Northlake has not shown that material and intentional misinformation was presented to the patent examiner, or that the district court's ruling that these tests did not establish inequitable conduct was based on clearly erroneous findings of fact or misapplication or misinterpretation of law, or manifested clear error of judgment.

We discern no clear error in the district court's finding that neither materiality nor intent to deceive or mislead was proved by clear and convincing evidence. The ruling that inequitable conduct was not established is affirmed.

Antitrust and Misuse Issues

Northlake states that Glaverbel violated the Sherman Act, 15 U.S.C. §§1 and 2, by bringing and continuing this lawsuit. The bringing of a lawsuit to enforce legal rights does not of itself constitute violation of the antitrust laws or patent misuse; there must be bad faith and improper purpose in bringing the suit, in implementation of an illegal restraint of trade. *See American Tobacco Co. v. United States*, 328 U.S. 781, 809 (1946) (otherwise lawful acts, when done to give effect to conspiracy to restrain trade, are forbidden); *Grip-Pak, Inc. v. Illinois Tool Works, Inc.*, 694 F.2d 466, 472 (7th Cir. 1982) (even if a lawsuit has a colorable basis, it can violate the antitrust laws if filed for an improper purpose), *cert. denied*, 461 U.S. 958 (1983). A purpose is improper if its goal is not to win a favorable judgment, but to harass a competitor and deter others from competition, by engaging the litigation process itself, regardless of the outcome. *See Professional Real Estate Investors, Inc. v. Columbia Pictures Industries, Inc.*, 113 S.

Ct. 1920, 1928, 26 USPQ2d 1641, 1646 (1993) ("sham" litigation must be "objectively baseless" and intended to use the litigation process to interfere directly with a competitor's business); *Carroll Touch, Inc. v. Electro Mechanical Systems, Inc.*, 15 F.3d 1573, 1581-83, 27 USPQ2d 1836, 1843-45 (Fed. Cir. 1993) (rejecting claim that filing a lawsuit was part of a scheme to restrain and monopolize trade, invoking the *Noerr-Pennington* immunity rule). *See also, e.g., Loctite*, 781 F.2d at 875, 228 USPQ at 100 (Under Seventh Circuit law, "[t]o establish an illegal attempt to monopolize, plaintiff must prove: (1) a specific intent to monopolize; and (2) a dangerous probability that the attempt would be successful in achieving a monopoly in the relevant market. . . . Had [the district court] found bad faith [here], it would have had to make specific findings defining the relevant geographic and product markets, and specifying the market share possessed by Loctite in the relevant market.")

The district court held that Northlake had not met its burden of demonstrating bad faith and improper purpose by Glaverbel in bringing this infringement suit, and did not discuss other elements of antitrust violation or patent misuse. Northlake now argues that even if bad faith in use of the litigation process were not shown, Glaverbel violated the antitrust laws because Glaverbel knew that its patents were invalid and not infringed when it brought suit, referring to the district court's summary judgment of non-infringement, discussed *post*. Northlake suggests that this litigation was part of an illicit scheme to monopolize the ceramic welding market.

[4] The district court found, and Northlake does not challenge, that Northlake did not dispute the accuracy of the test results on Northlake products, that were sent by Glaverbel to Northlake before this infringement suit was filed. Glaverbel had explained to Northlake how certain Northlake formulations infringed the claims of the '560 and the '022 patents, and invited Northlake to join with Glaverbel in determining "whether there is grounds for a resolution of this matter short of litigation." The district court's ruling that there was not bad faith by Glaverbel in filing or continuing the lawsuit was supported by Northlake's own witnesses, who did not unequivocally deny infringement. Northlake's charge of improper purpose was correctly rejected by the district court.

Northlake also states that it is being sued by Glaverbel in other countries for violation of Glaverbel's foreign patents on the same technology, and that the cost is "crippling." Parties who engage in international business may indeed encounter litigation in foreign courts; such actions, and their cost and consequences, do not of themselves constitute violation of the Sherman Act. It was Northlake's burden to show, *inter alia*, that Glaverbel's purpose was to harass Northlake in bad faith and regardless of the outcome. We have been directed to no evidence to this effect.

The determination that the antitrust and misuse laws were not violated is affirmed.

III
INFRINGEMENT

Glaverbel has cross-appealed from the district court's grant of Northlake's motion for summary judgment of non-infringement of the '022 and the '560 patents. We give plenary review to whether the issue was appropriately disposed of by summary judgment. *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 252 (1986); *Stark v. Advanced Magnetics, Inc.*, 29 F.3d 1570, 1573, 31 USPQ2d 1290, 1292 (Fed. Cir. 1994).

The district court held that Northlake's motion did not meet the requirements of Fed. R. Civ. P. 56(c) and (e), but nonetheless granted summary judgment in favor of Northlake. The district court held that since Glaverbel bore the burden of proving infringement, summary judgment would be entered against Glaverbel since it made an inadequately supported response to Northlake's inadequately supported motion. Glaverbel states that this was an improper shifting of the burdens on summary judgment; Glaverbel also states that it did meet the burden that the court placed upon it.

Northlake's Motion

Northlake's "Motion for Summary Judgment on the Issue of Infringement" was as follows:

> Now come defendants and respectfully request that the Court enter an order that:
> 1. Patent No. 4,489,022 is not infringed by using a process wherein the components are Si and Al together being present in an amount exceeding 15% and/or the Al is present in an amount exceeding 9% of the ceramic welding mix.
> 2. The following samples tested by or on behalf of Glaverbel do not infringe 4,489,022: Tests identified as Exhibit B, document £1605; Exhibit C, document £1585; Exhibit D, document £1589; and Exhibit E, document £1599.

3. That Patent No. 3,684,560 is not infringed by use of Si powder identified as 140 U.S. mesh used with Al powders having an average grain size exceeding 50 microns.

4. The Patent No. 3,684,560 is not infringed by use of Si powder identified as 200 U.S. mesh used with Al powders having an average grain size exceeding 50 microns.

5. The formulation tested by or on behalf of Glaverbel, identified as Exhibit E, document £1599, does not infringe 3,684,560.

The motion was accompanied, *inter alia*, by the referenced Exhibits B, C, D, and E, which were documents that Northlake had obtained from Glaverbel, containing the results of Glaverbel's tests of the four Northlake samples that are the subject of paragraphs 2 and 5. Northlake submitted no tests concerning the formulations described in paragraphs 1, 3, and 4.

Paragraphs 2 and 5

Glaverbel conceded that the samples of Exhibits B and C do not infringe the '022 patent. Glaverbel also conceded that the sample of Exhibit E does not infringe either the '022 or the '560 patent. The only other sample for which tests were submitted by Northlake was that of Exhibit D.

The purpose of summary judgment is to avoid an unnecessary trial, by enabling an expeditious procedure whereby, for issues on which there is no material factual dispute, the court can decide the controversy by applying the law to the undisputed facts. *Anderson*, 477 U.S. at 252; *Continental Can*, 948 F.2d at 1265, 20 USPQ2d at 1747. Rule 56 is a vehicle of convenience to parties and courts, for use when the circumstances warrant; but it is not a substitute for trial when decision of the controversy requires resolution of disputed factual issues. *See Celotex Corp. v. Catrett*, 477 U.S. 317, 327 (1986) (Rule 56 must be construed with due regard both to those persons entitled to trial and to those persons demonstrating that the claims have no factual basis.); *Dahnke v. Teamsters Local 695*, 906 F.2d 1192, 1195 (7th Cir. 1990) (doubt as to the existence of a material issue of fact is resolved against the movant).[3]

As discussed in *Celotex*, the "party seeking summary judgment always bears the initial responsibility of informing the district court of the basis for its motion, and identifying those portions of 'the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any,' which it believes demonstrate the absence of a genuine issue of material fact." 477 U.S. at 324 (quoting Rule 56(c)). In response, "the nonmoving party [must] go beyond the pleading and by her own affidavits, or by the 'depositions, answers to interrogatories, and admissions on file,' designate 'specific facts showing that there is a genuine issue for trial.'" *Id.* The initial burden is on the moving party. *See id.* at 325 ("Rule 56(e) was not designed to modify the burden of making the showing generally required by Rule 56(c)") (citing *Adickes v. S.H. Kress & Co.*, 398 U.S. 144, 159 (1970)). When the movant's burden of establishing the lack of a genuine issue of material fact has been met "in facial terms," the nonmovant must point to "some evidence in the record sufficient to suggest that his view of the issue might be adopted by a reasonable factfinder." *Resolution Trust Corp. v. Juergens*, 965 F.2d 149, 151 (7th Cir. 1992).[4]

Thus Northlake bore the initial burden of showing that there was an absence of evidence to support Glaverbel's cause. *Celotex*, 477 U.S. at 325. The district court, applying Rule 56(e),[5] rejected all of Northlake's exhibits as inadmissible, explaining that:

[3] The Federal Circuit follows the discernable law of the regional circuit in procedural matters that are not unique to patent law. *Allen Organ Co. v. Kimball Int'l, Inc.*, 839 F.2d 1556, 1563, 5 USPQ2d 1769, 1774 (Fed. Cir.), *cert. denied*, 488 U.S. 850 (1988). Thus for general procedure and practice under Rule 56 we look to the Seventh Circuit for precedential guidance.

[4] Other circuits are in accord. *See, e.g., Federal Deposit Insurance Corp. v. Giammettei*, 34 F.3d 51, 54 (2d Cir. 1994) (movant always bears the "burden of production" of informing the court the basis for its motion showing the absence of a genuine issue of fact); *Green v. Whiteco Industries, Inc.*, 17 F.3d 199, 202 (7th Cir. 1994) ("once [the movant] pointed out to the court that there was no evidence [to support the nonmovant's case, the nonmovant] then had the burden of countering this"); *LeBlanc v. Great American Insurance Co.*, 6 F.3d 836, 841 (1st Cir. 1993) (the "onus" initially falls on the moving party to demonstrate the absence of evidence to support the nonmovant's case); *Josey v. John R. Hollingsworth Corp.*, 996 F.2d 632, 637 (3d Cir. 1993) (after moving party has satisfied burden of demonstrating that no genuine issue of material fact exists, the burden shifts to the nonmoving party).

[5] Fed. R. Civ. P. 56(e). Form of Affidavits; Further Testimony; Defense Required.

Supporting and opposing affidavits shall be made on personal knowledge, shall set forth such facts as would be admissible in evidence, and shall show affirmatively that the affiant is competent to testify to the matters stated therein. Sworn or certified copies of all papers or parts

> [T]he defendants have submitted several exhibits without any authentication including uncertified file history records, applications, test results allegedly performed by the plaintiffs, and other test results and reports written in French. Although the plaintiffs did not object to the unauthenticated exhibits, the defendants' attorney cannot authenticate and interpret these tests by arguments made in his brief. Since the defendants have not submitted any authentication or translation, these documents cannot be considered admissible evidence.

Order at 7.

[5] In reviewing whether Northlake met the requirements of Rule 56, we need not address the evidence on the formulations in Exhibits B, C, and E, in view of Glaverbel's concession of noninfringement with respect to those formulations. Concerning the formulation described in Exhibit D, the district court ruled that Exhibit D was inadmissible, stating that "[e]xhibits which are offered with a motion for summary judgment must be identified by affidavits or otherwise admissible into evidence." Order at 6. However, Exhibit D appears to be an exhibit accompanying Mr. Mottet's deposition testimony, and apparently was received for that purpose without objection. The Seventh Circuit has stated that the trial court, in a summary judgment proceeding, may consider exhibits made a part of a deposition record. *Colan v. Cutler- Hammer, Inc.*, 812 F.2d 357, 365 n.14 (7th Cir.), *cert. denied*, 484 U.S. 820 (1987). Thus Exhibit D should have been considered.

Paragraphs 1, 3, and 4

Paragraphs 1, 3, and 4 in Northlake's motion asked the court to set limits to the patent claims, independent of any specific formulation or product in controversy. The district court did not discuss these paragraphs, but simply granted Northlake's motion in its entirety. These portions of Northlake's summary judgment motion were not described as having any support in terms of Rule 56(c) and (e). The potentially relevant exhibits were variously described by the district court as unauthenticated or uncertified or written in French without translation, and Northlake does not argue that they met the requirements of Rule 56. In addition, Northlake did not relate its general requests in paragraphs 1, 3, and 4 to any specific formulation supported by relevant evidence. *See Metalex Corp. v. Uniden Corp. of America*, 863 F.2d 1331, 1336- 37 (7th Cir. 1988) (party's argument on the substance of affidavit offered in support of summary judgment motion is "no substitute for evidence").

At most, Northlake met its initial burden as the movant with respect to the formulation of Exhibit D. As to paragraphs 1, 3, and 4, Northlake did not shift to Glaverbel the burden of coming forward with evidence in response; the grant of summary judgment as to the subject matter of paragraphs 1, 3, and 4 was improper.

Glaverbel's Response — Exhibit D

Responding to the motion with respect to Exhibit D, Glaverbel's attorney stated that "[the '022 patent] is infringed under the doctrine of equivalents. The test indicates 10.65% aluminum which is more than the literal number of 9% in the patent claim. But the result of using the powder is exactly the same." Although the official record is incomplete, it appears that Glaverbel offered no evidentiary support for its assertion of equivalency. There must be sufficient substance, other than attorney argument, to show that the issue requires trial. *Scherer v. Rockwell Int'l Corp.*, 975 F.2d 356, 361 (7th Cir. 1992) ("Argument is not evidence upon which to base a denial of summary judgment.") *See Anderson*, 477 U.S. at 257 ("the plaintiff must present affirmative evidence in order to defeat a properly supported motion for summary judgment").

We conclude that the district court correctly held that Glaverbel failed to demonstrate that there was a triable issue of fact as to the formulation in Exhibit D with respect to the '022 patent. Summary judgment of noninfringement of the '022 patent by the formulation in Exhibit D was correctly granted by the district court. As discussed *supra*, since Glaverbel conceded noninfringement as to the other formulations in paragraphs 2 and 5 of the motion, summary

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thereof referred to in an affidavit shall be attached thereto or served therewith. The court may permit affidavits to be supplemented or opposed by depositions, answers to interrogatories, or further affidavits. When a motion for summary judgment is made and supported as provided in this rule, an adverse party may not rest upon the mere allegations or denials of the adverse party's pleading, but the adverse party's response, by affidavits or as otherwise provided in this rule, must set forth specific facts showing that there is a genuine issue for trial. If the adverse party does not so respond, summary judgment, if appropriate, shall be entered against the adverse party.

judgment was properly granted as to those paragraphs.

[6] Northlake requested partial summary judgment as to specific formulations. However, as granted, the judgment encompassed all of Northlake's formulations, whether or not they were included in the motion. This was incorrect. *See Edwards v. Honeywell, Inc.*, 960 F.2d 673, 674 (7th Cir. 1992) (district court cannot grant summary judgment on a ground to which the nonmovant was given "either an inadequate opportunity or no opportunity to respond"). The summary judgment is limited to the four specific formulations of Exhibits B, C, D, and E, and to the patents identified in the relevant portions of the motion.

Summary

The district court's judgment on the issues of validity and enforceability is affirmed. The summary judgment of noninfringement is affirmed as to paragraphs 2 and 5 of the motion. In all other respects the summary judgment is reversed. The cause is remanded for further proceedings consistent herewith.

Costs in favor of Glaverbel.

AFFIRMED IN PART, REVERSED IN PART, AND REMANDED

U.S. Court of Appeals
Federal Circuit

Akro Corp. v. Luker

No. 94-1229

Decided January 20, 1995

JUDICIAL PRACTICE AND PROCEDURE

1. Procedure — Court of Appeals for the Federal Circuit (§410.03)

Federal Circuit law, rather than law of regional circuit in which case arose, will be applied to determine whether federal district court properly declined, in action seeking declaratory judgment of non-infringement and invalidity, to exercise jurisdiction over out-of-state patentee.

2. Jurisdiction — Personal jurisdiction (§405.11)

REMEDIES

Non-monetary and injunctive — Declaratory judgments (§505.05)

Federal district court in Ohio can, consistent with Fifth Amendment due process, exercise personal jurisdiction, in action brought by Ohio corporation seeking declaratory judgment of patent non-infringement and invalidity, over out-of-state patentee who, through counsel, sent warning letters to corporation and its North Carolina counsel, and who has been shown to have entered into exclusive license agreement with Ohio licensee, since patentee has purposefully directed activities regarding patent in suit at residents of Ohio, since declaratory judgment action arises out of those activities, and since exercise of jurisdiction over patentee has not been shown to be unconstitutionally unreasonable.

Particular patents — Chemical — Floor mat

4,871,602, Luker, floor mat with band of higher density tufting, dismissal of declaratory judgment action reversed.

Appeal from the U.S. District Court for the Northern District of Ohio, Bell, J.

Action by The Akro Corp. against Ken Luker for declaratory judgment of patent non-infringement, invalidity, and unenforceability. From federal district court decision dismissing action for lack of personal jurisdiction, plaintiff appeals. Reversed and remanded.

James D. Myers, Dickson M. Lupo, and George M. Taulbee, of Bell, Seltzer, Park & Gibson, Charlotte, N.C., for appellant.

Bruce H. Wilson, Mark A. Watkins, and Kenneth A. Godlewski, of Oldham, Oldham & Wilson Co., Akron, Ohio, for appellee.

Before Michel, circuit judge, Bennett, senior circuit judge, and Rader, circuit judge.

Michel, J.

Akro Corporation (Akro) appeals from the February 9, 1994 judgment of the U.S. District Court for the Northern District of Ohio, No. 5:93CV2207, dismissing Akro's action for declaratory judgments of noninfringement, invalidity, and unenforceability. The trial court entered judgment pursuant to Federal Rule of Civil Procedure 12(b)(2), dismissing Akro's action for want of personal jurisdiction over Ken Luker (Luker), the

doubts should be resolved in favor of the policy expressed in *Beacon Theatres* and *Dairy Queen* favoring jury trials of factual issues, we believe that *Dairy Queen, Ross* and *Curtis* entitled Hartmarx to a jury trial on its claim for profits under 15 U.S.C. §1117.

[3] Since the jury trial was proper in this case the court may overturn its findings of fact only under the standards for granting a motion for judgment notwithstanding the verdict. The court does not agree with the Oxford's contention, based on the Fifth Circuit's opinion in *Sheila's Shine Products, Inc. v. Sheila Shine, Inc.*, 486 F.2d 114 at 121-22 [179 USPQ 577] (5th Cir. 1973), that the court may make its own findings of fact in deciding whether to grant an injunction. While the court sitting in equity has considerable discretion in determining the scope of an injunction, it may not substitute its own findings on validity or infringement unless it properly enters a judgment notwithstanding the verdict on the legal claim. See *Hussein v. Oshkosh Motor Truck Co.*, 816 F.2d 348, 355 (7th Cir. 1987) (jury's verdict on §1981 claim would bind the court in considering equitable relief under Title VII). Otherwise the jury's verdict would not be *res judicata* as to the issues properly submitted for jury determination. *In re Lewis*, 845 F.2d 624, 629 (6th Cir. 1988).

Oxford's motion to vacate the judgment entered December 1, 1989 is granted. Oxford's motion for the entry of the court's findings of fact and conclusions of law is denied.

Pending before the court are the following:

(1) Oxford motion for directed verdict, judgment notwithstanding the verdict and for new trial. Oxford shall submit its brief in support of this motion by May 15, 1990. Hartmarx's response will be due May 22, 1990, and Oxford's reply by May 29, 1990.

(2) Hartmarx motion for attorney's fees and costs. Oxford's response is due May 15, 1990 and Hartmarx's reply May 22, 1990.

(3) Hartmarx motion for injunction. This motion has been briefed. Oxford argues that an additional hearing is needed before the issue of injunctive relief may be determined. Oxford is to submit by May 15, 1990 an offer of proof setting forth the facts not contained in the record which it proposes to establish at such a hearing. That statement shall specify how each such fact will be proved, i.e., by documents or testimony, identifying the specific documents and witnesses. Hartmarx shall respond to that offer of proof by May 22, 1990, and shall include a statement specifying which facts listed in Oxford's offer of proof are disputed.

A hearing is set for June 14, 1990 at 2:30 p.m. at which time the court will hear argument on all pending motions and any additional matters which must be addressed before the entry of final judgment.

Court of Appeals, Federal Circuit

In re Spada

No. 90-1109

Decided August 10, 1990

PATENTS

1. Patentability/Validity — Anticipation — Prior art (§115.0703)

Rejection for anticipation requires, as first step in inquiry, that all elements of claimed invention be described in single reference, and such reference must describe applicant's claimed invention sufficiently to have placed person of ordinary skill in possession of it.

2. Patentability/Validity — Anticipation — Prior art (§115.0703)

Discovery of new property or use of previously known composition, even if unobvious from prior art, cannot impart patentability to claims to known composition.

3. Patentability/Validity — Anticipation — Prior art (§115.0703)

Board of Patent Appeals and Interferences did not err in finding that virtual identity of monomers and procedures between claimed pressure-sensitive adhesive composition and prior art is sufficient to support prima facie case of unpatentability of polymer latex claims for lack of novelty; applicant has burden, in face of such prima facie case, of showing that his polymer compositions are different from those described by prior art, and such burden is not met by simply including assertedly different properties in claims.

Appeal from the U.S. Patent and Trademark Office, Board of Patent Appeals and Interferences.

Application for patent, serial no. 859,057, filed May 2, 1986 by Lonnie T. Spada and Joseph J. Wilczynski. From decision rejecting claims, applicants appeal. Affirmed.

James H. Laughlin, Jr., of Benoit, Smith & Laughlin, Arlington Va. (Michael H.

Laird, Brea, Calif., with him on brief), for appellant.

John H. Raubitschek, associate solicitor (Fred E. McKelvey, solicitor, with him on brief), for appellee.

Before Newman and Mayer, circuit judges, and G.E. Brown, district judge (District of New Jersey, sitting by designation).

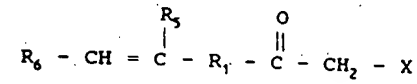
Newman, J.

The decision of the United States Patent and Trademark Office (the PTO) Board of Patent Appeals and Interferences (the Board), rejecting claims 2 through 25 and 27 through 31, all the claims at issue of Spada and Wilczynski (hereinafter Spada) patent application Serial No 859,057, filed May 2, 1986 and entitled "Pressure Sensitive Adhesives and Manufactured Articles", is affirmed.

The Invention

The Spada invention is a pressure sensitive adhesive composition comprising a water-based latex containing a normally tacky copolymer made from specified classes and proportions of monomers and having a glass transition temperature (T_g)[1] of O°C or less. Claim 31 was treated by the parties as representative:

> Claim 31. A pressure sensitive adhesive composition comprising a water-base latex comprising a continuous aqueous medium containing dispersed particles of a normally tacky polymer having a T_g of about O°C. or less and comprising at least about 60 weight percent olefinically unsaturated carboxylic acid ester monomers and at least about 0.1 weight percent of at least one polymerizable functional monomer of the formula:



in which R_1 is a divalent organic radical of at least 3 atoms in length, R_5 and R_6 are independently selected from hydrogen, hydroxy, halo, thio, amino or monovalent organic radicals, and X is -Co-R_4 or -CN wherein R_4 is hydrogen or a monovalent organic radical.

The Spada disclosure broadly is coextensive with claim 31. While claim 31 requires that the polymers comprise members of two general classes of monomers, Spada's specific examples illustrate polymers in which members of three general classes of monomers are present.

The first class of monomer required by Spada is an olefinically unsaturated carboxylic acid ester that is present in at least about 60 weight percent of the polymer. Representative examples show 96.5 weight percent butyl acrylate (Example 2), and a combination of 48 weight percent butyl acrylate and 48 weight percent 2-ethylhexyl acrylate (Example 11).

Spada's second required class of monomer is a "polymerizable functional monomer" present in "at least about 0.1 weight percent" of the polymer (claim 31). The illustrative examples show 1-2 weight percent acetoacetoxyethyl methacrylate (AAEMA).

Spada's specification states that preferred polymer compositions include at least about 0.1 weight percent of a third class of monomer, an olefinically unsaturated carboxylic acid. Examples are 1.5 weight percent methacrylic acid (Example 2) and 3 weight percent acrylic acid (Example 7).

All of Spada's claims require that the T_g of the claimed tacky polymers is about O°C or less, and that the products are pressure-sensitive adhesives.

The claims were rejected as unpatentable in view of the Smith reference, United States Patent No. 3,554,987, issued January 12, 1971. The Spada disclosure and the Smith reference both show polymers of the same monomers, in overlapping ratios of components. However, the products that Smith and Spada obtain are described as quite different.

The Smith Reference

Smith describes water-based latexes containing dispersed particles of polymers made from certain classes and proportions of monomers. The polymers are used in binding agents in photographic gels and films.

In most of Smith's examples three monomers are present, as in Spada's examples. The first monomer in Smith's preferred polymers is an olefinically unsaturated carboxylic acid ester, in at least 50 percent by weight of polymer. In Smith's examples this component is illustrated, inter alia, as 75.7 molar percent butyl acrylate (Example 5), and 72.4 weight percent ethyl acrylate (Example 15).

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[1] Glass transition temperature (T_g) is defined as the temperature (or temperature range) at which an amorphous polymer changes from a hard, rigid, glassy state to a soft, flexible, rubbery state. S. Rosen, *Fundamental Principles of Polymeric Materials* §8.1 (1982).

Smith's second monomer used in preparing his preferred polymers is a polymerizable functional monomer like that described by Spada, present in about 2–20 weight percent of the polymer. Smith's examples include polymers containing 9.4 molar percent of acetoacetoxyethyl acrylate (AAEA) (Example 5), and 3.5 weight percent AAEMA (Example 15). Spada incorporated by reference the entire disclosure of the Smith patent, as showing polymerizable functional monomers suitable and preferred for use in the Spada polymers, and the preparation of these monomers.

The preferred polymers of Smith contain a third monomer, as do Spada's, and most of Smith's examples include acrylic acid. Thus, in Smith's Example 5 the complete polymer composition is 75.7 molar percent butyl acrylate, 9.4 molar percent AAEA, and 14.9 molar percent acrylic acid. In Smith's Example 15 the composition is 72.4 weight percent ethyl acrylate, 3.5 weight percent AAEMA, and 24.1 weight percent acrylic acid.

Smith states that emulsions containing his polymers have improved properties of hardness, resistance to abrasion, good adhesion, and dimensional stability. Smith does not show or suggest that his polymer latexes can form a normally tacky pressure-sensitive adhesive — properties admitted to be different from hardness and abrasion resistance.

Discussion

The Board affirmed the rejection of Spada's claims under 35 U.S.C. §102/103, this hybrid rejection having apparently been made on the theory that if the claimed subject matter was novel, i.e. not anticipated, in terms of section 102, then it would have been obvious under section 103.[2] The Commissioner on this appeal concentrates on the rejection for anticipation. The Commissioner argues that a *prima facie* case [3] of anticipation is made by the Smith disclosure of polymers that are apparently identical to those of Spada, although the properties described by Smith are different from those that are reported by Spada and included as express limitations in Spada's claims.

[1] Rejection for anticipation or lack of novelty requires, as the first step in the inquiry, that all the elements of the claimed invention be described in a single reference. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir.), *cert. denied*, 110 S.Ct. 154 (1989). Further, the reference must describe the applicant's claimed invention sufficiently to have placed a person of ordinary skill in the field of the invention in possession of it. *Akzo N.V. v. United States Int'l Trade Comm'n*, 808 F.2d 1471, 1479, 1 USPQ2d 1241, 1245 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987); *In re Coker*, 463 F.2d 1344, 1348, 175 USPQ 26, 29 (CCPA 1972).

Spada argues that Smith does not describe Spada's claimed invention, for to find anticipation "all limitations in the claims must be found in the reference since the claims measure the invention." *In re Lange*, 644 F.2d 856, 862, 209 USPQ 288, 293 (CCPA 1981). Spada states that since his compositions are claimed as pressure-sensitive adhesives containing a tacky polymer having a T_g below 0°C, they can not be anticipated. Spada argues that since the Smith products are hard, abrasion-resistent solids, they are *ipso facto* different.

[2] The discovery of a new property or use of a previously known composition, even when that property and use are unobvious from the prior art, can not impart patentability to claims to the known composition.[4] *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 780, 782, 227 USPQ 773, 777–78, 778 (Fed. Cir. 1985); *In re Pearson*, 494 F.2d 1399, 1403, 181 USPQ 641, 644 (CCPA 1974); *In re Lemin*, 326 F.2d 437, 440, 140 USPQ 273, 276 (CCPA 1964). Thus, the initial inquiry is to the novelty of the composition. *Titanium Metals*, 778 F.2d at 780, 227 USPQ at 777.

The Board held that the compositions claimed by Spada "appear to be identical" to those described by Smith. While Spada criticizes the usage of the word "appear", we think that it was reasonable for the PTO to infer that the polymerization by both Smith and Spada of identical monomers, employing

[2] The court has accepted the PTO's practice of basing rejections on sections 102 or 103 in the alternative, provided that the appellant was fully apprised of all the grounds of rejection. *See, e.g., In re Pearson*, 494 F.2d 1399, 1402 & nn. 2–3, 181 USPQ 641, 644 & nn. 2–3 (CCPA 1974).

[3] The *prima facie* case is a procedural tool which, as used in patent examination (as by courts in general), means not only that the evidence of the prior art would reasonably allow the conclusion the examiner seeks, but also that the prior art compels such a conclusion if the applicant produces no evidence or argument to rebut it. *See Black's Law Dictionary* 1071 (5th Ed. 1979). *See generally In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984) (citing cases showing the evolution of the concept in patent examination of *prima facie* obviousness as a legal inference drawn from uncontradicted evidence). Upon rebuttal, the decision is made on the entirety of the record. *Id.*

[4] All of Spada's claims are composition claims. The issue is not before us of whether Spada may have discovered a new use of a known composition, which use may be patentable as a process. 35 U.S.C. §101. *See In re Hack*, 245 F.2d 246, 248, 114 USPQ 161, 163 (CCPA 1957).

the same or similar polymerization techniques, would produce polymers having the identical composition. Products of identical chemical composition can not have mutually exclusive properties. *See In re Papesch*, 315 F.2d 381, 391, 137 USPQ 43, 51 (CCPA 1963) (a chemical compound and its properties are inseparable).

[3] While the art and science of polymer chemistry may be distinguished from that of simpler compounds and compositions, in Spada's case we conclude that the Board correctly found that the virtual identity of monomers and procedures sufficed to support a *prima facie* case of unpatentability of Spada's polymer latexes for lack of novelty. See, e.g., *In re Thorpe*, 777 F.2d 695, 697-98, 227 USPQ 964, 966 (Fed. Cir. 1985), wherein the examiner's rejection of product-by-process claims under §102/103, based on similarity of reactants, reaction conditions, and properties, amounted to a *prima facie* case of unpatentability.

In response to the PTO's asserted *prima facie* case the applicant may argue that the inference of lack of novelty was not properly drawn, for example if the PTO did not correctly apply or understand the subject matter of the reference, or if the PTO drew unwarranted conclusions therefrom. However, when the PTO shows sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not. *In re King*, 801 F.2d 1324, 1327, 231 USPQ 136, 138 (Fed. Cir. 1986); *In re Ludtke*, 441 F.2d 660, 664, 169 USPQ 563, 566 (CCPA 1971). Spada offered no such showing.

The Board suggested that Spada provide some scientific explanation for the asserted differences between the properties of his compositions and those described by Smith. While an inventor is not required to understand how or why an invention works, we think that the PTO was correct, in view of the apparent identity of the compositions, in requiring Spada to distinguish [5] his compositions from those of Smith. Although newly discovered properties can be the basis of claims to *novel* polymers, *E.I. DuPont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1435, 7 USPQ2d 1129, 1133 (Fed. Cir.), *cert. denied*, 109 S.Ct. 542 (1988), Spada did not overcome, with argument or evidence, the apparent chemical identity of his polymers and those of Smith. Spada showed no error, in science or in law, in the Board's holding that the products appeared to be the same and thus that Spada's products were not new.

Spada pointed to his data wherein polymers containing varying amounts of AAEMA showed greatly increased shear strength without significant loss in tack, compared with polymers without the AAEMA. We agree with Spada that this result is not suggested in the Smith reference. However, these data did not relate to the fundamental question of the novelty of Spada's compositions in view of those of Smith. Without novelty, evidence of unobviousness is superfluous.

As we observed *supra*, discovery of an unobvious property and use does not overcome the statutory restraint of section 102 when the claimed composition is known. While Spada's position is that his polymers are not anticipated by the polymers of Smith because their properties are different, Spada was reasonably required to show that his polymer compositions are different from those described by Smith. This burden was not met by simply including the assertedly different properties in the claims. When the claimed compositions are not novel they are not rendered patentable by recitation of properties, whether or not these properties are shown or suggested in the prior art.

The Board's decision rejecting all of the claims is

AFFIRMED.

[5] It was discussed at oral argument that the Spada invention may not be "particularly point-[ed] out and distinctly claim[ed]", in the words of 35 U.S.C. §112, paragraph 2. No rejection had been made under section 112. The Solicitor stated that such a rejection was inappropriate because the claims were "not vague". *But see Burlington Indus. v. Quigg*, 822 F.2d 1581, 1583-84, 3 USPQ2d 1436, 1438 (Fed. Cir. 1987) (whether claims were too broadly written is not a section 103 determination but an issue of claim imprecision under section 112). *See also In re Muchmore*, 433 F.2d 824, 824-25, 167 USPQ 681, 682 (CCPA 1970) ("there is sometimes a close relationship between indefiniteness under §112, second paragraph and obviousness under §103").

District Court, E.D. Michigan

Dana Corp. v. IPC Limited Partnership

No. 86-CV-70231-DT

Decided April 10, 1990 and May 21, 1990

PATENTS

1. Infringement — Defenses — Breach of duty of disclosure or inequitable conduct (§120.1111)

REMEDIES

Monetary — Attorney's fees; costs — Patents (§510.0905)

Patent infringement plaintiff's failure to disclose fluoride surface treatment necessary

Court of Appeals, Federal Circuit

Kloster Speedsteel AB, et al. v. Crucible Inc., et al.

Nos. 85-2174, 85-2214, 85-2215 and 85-2274

Decided June 11, 1986

PATENTS

1. Patentability — Anticipation — In general (§51.201)

Federal district court properly found that prior art patent did not anticipate claimed alloy body, despite evidence that prior art figure could be scaled to match claims limitations, since nothing in prior art patent discloses actual size of carbide particles.

2. Patentability — Anticipation — Process (§51.225)

Patentability — Invention — Specific cases — Chemical (§51.5093)

Testimony, in declaration of infringement action, as to whether processes of prior art would result in product having properties of claimed alloy body, which led federal district court to discuss processes in its opinion, does not establish that court erroneously based its judgment on view that claimed invention was process.

3. Patentability — Invention — Specific cases — Chemical (§51.5093)

Claimed alloy body's achievement in doing what those skilled in art suggested should not be done—of using lower temperatures and limiting carbide size—is strongly probative of non-obviousness.

4. Patentability — Tests of — Skill of art (§51.707)

Patent challenger's contention that federal district court erred when it did not find specific level in art is without merit, since patent challenger was not prejudiced by court's having looked to other inventors, rather than one of ordinary skill.

5. Patentability — Evidence of — Commercial success — In general (§51.4551)

Patent challenger's attempt to denigrate commercial success of claimed invention, to which it and patent holder had earlier stipulated, by citing delay between patent application and commercial success, is not valid, since mere passage of time may not be enough to discredit nexus with commercial success, since patent challenger has shown no basis for its attack, and since federal district court attributed proper weight to other objective evidence, such as filling of longfelt and unsolved need, failure of others, and wide acceptance of claimed invention.

6. Accounting — Increased or treble damages or profits (§11.35)

Federal district court's refusal to impose increased damages does not mean that court found infringement not willful, but if such finding is implicit, it is clearly erroneous, in view of accused infringer's failure to seek advice of counsel, despite patent holder's warnings, and its admitted "strategy" of continuing infringement in hope that court would hold patent invalid.

7. Injunction — In general (§40.1)

Infringement — Contributory infringement (§39.30)

Corporation that was created by infringer immediately after conclusion of patent infringement trial and before judgment, in order to evade effect of possible injunction, and that purchased facility infringer used to manufacture products found to infringe, is bound by injunction, and may appeal federal district court's refusal to modify it, despite agreement between infringer and corporation that corporation accepted no liability for infringement.

Particular patents — Alloys

3,561,934, Steven, Sintered Steel Particles Containing Dispersed Carbides, holding of validity affirmed.

3,746,518, Holtz, Jr., Alloy Composition and Process, holding of validity of claim 30 affirmed.

Appeal from District Court for the Western District of Pennsylvania, Diamond, J.; 226 USPQ 36.

Consolidated actions by Crucible Inc., against Stora Kopparbergs Bergslags, AB, and Uddeholms, AB, for patent infringement, and by Stora Kopparbergs Coporation, and Uddeholm Steel Corporation, against Crucible Inc., Crucible Materials Corp., et al., for declaration of patent invalidity. From judgment for Crucible Inc., et al., Kloster Speedsteel AB, et al., appeal. Affirmed in part and remanded in part.

See also 224 USPQ 714 and 226 USPQ 842.

Francis J. Hone, and Brumbaugh, Graves, Donohue & Raymond, both of New York, N.Y. (Richard S. Clark, and Brumbaugh, Graves, Donohue & Raymond, both of New York, N.Y., on the brief) for Stora, et al.

Wayne A. Cross, New York, N.Y. (William Dunnegan, Reboul, MacMurray, Hewitt, Maynard & Kristol, Arthur D. Gray, Stuart J. Sinder, William J. McNichol, Scott A. Wisser, and Kenyon & Kenyon, of counsel) for Kloster, et al.

Ford R. Farabow, Jr., and Finnegan, Henderson, Farabow, Garrett & Dunner, both of Washington, D.C. (Michael C. Elmer, Allen M. Sokal, and Finnegan, Henderson, Farabow, Garrett & Dunner, on the brief) for Crucible, et al.

Before Markey, Chief Judge, Nichols, Senior Circuit Judge, and Newman, Circuit Judge.

Markey, Chief Judge.

Consolidated appeals from a judgment of the United States District Court for the Western District of Pennsylvania holding claim 30 of U. S. Patent No. 3,746,518 ('518 patent) and claim 4 of U. S. Patent No. 3,561,934 ('934 patent) valid and infringed. *Crucible, Inc.* v. *Stora Kopparbergs Bergslas AB*, 594 F. Supp. 1249, 226 USPQ 36 (W.D. Pa. 1984). We affirm in part and remand in part.

Background

(1) *Proceedings in the District Court*

In 1974, Crucible, Inc. (Crucible), assignee of the '518 patent (issued July 17, 1973 to Frederick C. Holtz, Jr., on an application filed February 26, 1965), and of the '934 patent (issued February 9, 1971 to Gary Steven on an application filed September 11, 1967), charged Stora Kopparbergs Bergslags AB and Stora Kopparberg Corp. (Stora) with patent infringement in manufacturing and selling "ASP" steel products. On July 25, 1974, Stora filed a declaratory judgment action in the United States District Court for the District of New Jersey alleging patent invalidity, noninfringement, and violation of the antitrust laws. On October 4, 1974, Crucible [1] sued Stora [2] in the Western District of Pennsylvania, where the district court consolidated the suits and severed the antitrust and damage issues for later trial.

In 1976, a proceeding was initiated in the Patent and Trademark Office (PTO) on Stora's protest against a continuing application related to the '518 patent. Crucible's failure to cite a reference during prosecution of the application that resulted in the '518 patent was reviewed in that proceeding.

The district court tried the case without a jury on 18 dates between September 13 and October 6, 1982, filed an opinion on September 19, 1984, and entered judgment for Crucible on October 11, 1984. The court held that: (1) claim 30 of the '518 patent had not been proved invalid under 35 U.S.C. §§102, 103, or 112, and was infringed by Stora. (2) claim 4 of the '934 patent had not been proved invalid under 35 U.S.C §§102 or 103;[3] (3) Stora had waived its defense that the patents were unenforceable because of inequitable conduct; (4) Crucible was not entitled to increased damages; and (5) no litigant was entitled to attorney fees. In its October 11, 1984 order, the court permanently enjoined Stora and its "successors in interest and assigns" from making infringing ASP steel products.

On October 31, 1982, the 25th day after trial and almost two years before the court's decision, Fagersta AB, a Swedish corporation, and Stora formed Kloster Speedsteel AB and its subsidiary, Speedsteel of New Jersey, Inc. (Kloster), and Kloster purchased the facility Stora used to make the infringing products.

In a March 12, 1985 order disposing of post-trial motions, the district court reviewed its decision and opinion in light of arguments presented by Stora (and repeated by Stora before us). The court: (1) denied a motion by Kloster to modify the injunction by excluding Kloster or by deleting "successors in interest and assigns"; (2) refused to stay the injunction pending appeal; (3) amended the October 11, 1984 order to enjoin Stora from infringing the specifically upheld claims; and (4) anticipating an appeal, amended its opinion to enter a finding that undisclosed art was not more material than that considered by the examiner, and that, if Stora had not waived its unenforceability defense, it had in any event failed to establish inequitable conduct before the PTO. 226 USPQ 842 (W.D. Pa. 1985).

Stora in Appeal No. 85-2215 and Kloster in Appeal Nos. 85-2174/2274 [4] contest the de-

[1] Crucible Materials Corp., the successor in interest of Crucible, Inc., was added as a plaintiff in an order dated October 11, 1984.

[2] In 1977, Uddeholms AB purchased the division of Stora that manufactured ASP steel. Uddeholms and its American marketing subsidiary, Uddeholm Steel Corp., now called Uddeholm Corp., were joined as defendants and are included here under "Stora".

[3] Stora admitted infringement of claim 4 of the '934 patent. 594 F.Supp. at 1251, 226 USPQ at 37.

[4] The district court, apparently through inadvertence, left "successor in interest and assigns" out of its March 12, 1985 injunction order from which Kloster appealed on March 21, 1985 (85-2174). The court included the phrase in its injunction order

termination that Stora had not shown the claims invalid,[5] and Kloster contests the refusal to modify the injunction. In Appeal No. 85-2214, Crucible cross-appeals from the portion of the judgment refusing to find willful infringement and denying increased damages under 35 U.S.C. §284 and attorney fees under 35 U.S.C. §285. On stipulated motion, this court consolidated the appeals on June 14, 1985.[6]

(2) *The Technology*

The present field of technology is that of metal alloy compositions. The focus at trial was on "high speed" tool steels used to make metal cutting tools. High speed tool steels must possess properties of grindability, heat resistance, hardness, toughness, and dimensional stability. Those properties minimize tool replacement and resulting production line shutdowns.

High speed tool steels generally contain relatively large amounts of carbon and significant amounts of alloying elements that form metallic carbides distributed throughout the microstructure of the steel. Conventionally cast high speed tool steels have a microstructure characterized by an inhomogeneous distribution of coarse carbides, i.e., striations and stringers resulting primarily from the time required to cool the ingot. That carbide distribution adversely affects grindability and cutting efficiency.

Prior art workers investigated powdered metallurgical techniques. Those workers initially produced a particulate alloy, preferably by atomization, and then applied heat and pressure to consolidate the resulting powders into an integral product.

To achieve substantially full density, workers had to compact the powders at elevated temperatures. High temperatures, however, cause increased rate of carbide growth and agglomeration and loss of carbon. Low temperatures, on the other hand, render the powder insufficiently malleable for suitable densification. Thus, prior art workers had to choose between high densification and fine carbide size. The invention disclosed in the '518 patent made it possible for the first time to maintain fine, uniformly dispersed carbides while achieving a fully dense product having satisfactory interparticle bonding.

(3) *The Claims in Suit*

Claim 30 of the '518 patent reads:

> A consolidated integral alloy body which is substantially fully dense formed of a hot worked supersaturated solid solution of an inherently alloying composition, said alloy body consisting essentially of a continuous metallurgical phase with a uniformly dispersed hard phase of minute dispersed hard phase particle sizes that are substantially entirely less than three microns in maximum dimension, said alloying composition consisting essentially by weight from about .5% to about 5% carbon at least 10% of a hard phased forming element selected from the group consisting of Cr, W, Mo, Ti, Ta, Cb, Zr, Hf, V, and Al, and mixtures thereof, and the remainder base metal and incidental impurities, wherein said base metal is selected from the group consisting of cobalt, iron and nickel, and wherein the total amount of base metal is at least 30%.

Claim 4 of the '934 patent reads:

> An article of manufacture as defined in claim 2, in the form of a hob for use in milling applications.

On May 2, 1978, Crucible disclaimed, under 35 U.S.C. §253, claim 1 and its dependent claim 2 of the '934 patent. Because it depends from and thus includes all limitations of claims 1 and 2, however, claim 4 properly reads:

> As an article of manufacture, a metal body constructed of compacted particles of a high speed tool or die steel composition containing a metal component capable of reacting with carbon to form carbides, said reactive metal component being at least one metal selected from the group consisting of titanium, vanadium, molybdenum, zirconium, columbium, tungsten and tantalum each of said particles having carbides of said reactive metal substantially evenly dispersed throughout, said body having a hardness of at least about 58 R_c and being characterized by size change uniformity upon austenitising, quenching and tempering, the composition of said metal body [consisting] of, in percent, 0.80 to 3.00 carbon, up to 2 manganese, up to 1 silicon, up to 0.5 sulfur, up to 18.0 tungsten, up to 10.0 chromium, up to 12 molybdenum, up to 5 vanadium, up to 12 cobalt and balance iron, with tungsten + molybdenum + chromium + vanadium being equal to at least 10 percent, [said metal body being] in the form of a hob for use in milling applications.

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dated March 25, 1985, from which Kloster also appeals (85-2274). *See* Fed. R. App. P. 4(a)(4).

[5] The issues of validity under 35 U.S.C. §112 and infringement are not contested on appeal.

[6] On November 4, 1985, this court dismissed the appeal of Fagersta AB in response to a stipulated motion of all parties.

Issues Presented

Whether the district court erred in: (1) refusing to hold the asserted claims invalid; (2) refusing to hold the patents unenforceable; (3) denying increased damages and attorney fees; and (4) enjoining Stora's "successors in interest and assigns".

OPINION

(1) Validity

To meet its burden at trial, Stora was required to prove by clear and convincing evidence facts compelling a conclusion of invalidity. *See Datascope Corp. v. SMEC, Inc.*, 776 F.2d 320, 323-24, 227 USPQ 838, 840-41 (Fed. Cir. 1985). To meet its burden on appeal, Stora must persuade this court that the district court committed reversible error in determining that it had failed to meet its burden at trial. It must do so by convincing us that the court's probative findings underlying its holdings on validity were clearly erroneous or that its legal conclusions on that issue cannot be supported by those findings or are incorrect as a matter of law. *Atlas Powder Co. v. E. I. DuPont De Nemours*, 750 F.2d 1569, 1573, 224 USPQ 409, 411 (Fed. Cir. 1984).

A. Claim 30 of the '518 Patent

The district court properly noted that Stora failed to proffer prior art more pertinent than that considered by the PTO and therefore had the "added burden of overcoming the deference that is due to a qualified government agency presumed to have properly done its job." *American Hoist & Derrick Co. v. Sowa Sons, Inc.*, 725 F.2d 1350, 1359, 220 USPQ 763, 770 (Fed. cir.), *cert. denied*, 105 S. Ct. 95, 224 USPQ 520 (1984). That deference merely recognizes the statutory mandate that all patents shall be presumed valid. 35 U.S.C. §282; *see Fromson v. Advance Offset Plate, Inc.*, 755 F.2d 1549, 1555, 225 USPQ 26, 31 (Fed. Cir. 1985).

The court appropriately gave weight to two PTO Board of Appeals (Board) decisions on the application that related to that on which the '518 patent issued. The Board there resolved issues pertinent to those presented to the district court in this case. *See In re Holtz*, 224 USPQ 714 (Bd. App. 1984) (materiality of uncited art); *In re Holtz*, Appeal No. 470-30 (Bd. App. Aug. 6, 1981) (unpublished) (obviousness). Stora fully participated since 1976 in the PTO proceedings that led to those decisions. Because both sides agreed at trial that the PTO's decisions should be accorded "great weight by the court," Stora's assertion on appeal that the district court gave undue deference to the PTO decisions comes with poor grace.

(a) Anticipation

Stora says the district court should have found claim 30 anticipated under §102 by the disclosure in U. S. Patent No. 3,150,444, issued September 29, 1964 to Orville W. Reen (Reen patent). Relying principally on figure 2 of the Reen patent, Stora says that figure can be scaled and the carbide particles it shows can then be measured at three microns or less. Stora, however, must show that each element of the claim is found in that single prior art reference. *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771, 218 USPQ 781, 789 (Fed. Cir. 1983), *cert. denied*, 465 U.S. 1026, 224 USPQ 520 (1984). The corollary of that rule is that absence from the reference of any claimed element negates anticipation. *Atlas Powder Co.*, 750 F.2d at 1573-74, 224 USPQ at 411. The district court found no anticipation. That finding is reviewed under the clearly erroneous standard. *Id.*

[1] The district court found, as had the PTO, that nothing in the Reen patent discloses the actual size of the carbides, 594 F. Supp. at 1255, 226 USPQ at 40, and Stora has not shown that finding to have been clearly erroneous. Patent drawings are not drawn to scale, and that a defendant may when sued so measure a drawing as to match one limitation relating to size does not establish anticipation. In all events, the district court found that the Reen patent fails to disclose other elements, and Stora has not shown that finding to have been clearly erroneous.

(b) Obviousness

Stora says the district court made erroneous findings and misapplied the law under 35 U.S.C. §103, even though the court cited *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966). More specifically, Stora contends that the district court: (i) considered and discussed only the process disclosed in the '518 patent, not the product set forth in claim 30; (ii) failed to ascertain differences between the invention set forth in claim 30 and the prior art; (iii) failed to find the level of ordinary skill; and (iv) gave undue weight to the objective evidence because it bore no nexus with the claimed invention.

(i) Process

Stora builds its first argument on one sentence in the court's opinion in which it called the invention a "method and process." On the presence of that single sentence, Stora says attributes of method claims in the '518 patent were "brought into play to save claim 30."

[2] In its focus on the phraseology in the court's opinion, Stora reflects its failure to appreciate the appellate function. This court reviews judgments, not phrases. *Fromson*, 755 F.2d at 1556, 225 USPQ at 31. To be relevant on appeal, phrases in a trial court's opinion must be shown not only to have been used in error, but must be shown to have served as the basis of the judgment appealed from. Stora makes no such showing. On the contrary, Stora simply disregards references by the district court to the claimed invention as a product. Much testimony on both sides related to whether the processes of the prior art would result in a product having the properties of the alloy body claimed, and the court was led thereby to discuss processes in its opinion. That fact does not establish, however, that the court based its judgment on the view that the invention of claim 30 was a process.

(ii) Differences

Stora's principal prior art references are: the Reen patent; *Progress Report on Hot Forging Prealloyed Metal Powders*, 10 Precision Metal Molding 38 (Nov. 10, 1952) by Lambert H. Mott (Mott); and British Patent No. 781,083 issued August 14, 1957 to Gregory J. Comstock (Comstock).

Stora urges this court to find that the Reen patent disclosed temperatures similar to those disclosed in the '518 patent and that therefore Reen need not have included a warning against carbide growth. We are also asked, as was the district court, to reexamine the figure in Reen and measure the size of carbide particles in the figure.

The role of this court on appeal from a judgment of a district court is not that of an examiner considering a claim in an application in light of the prior art. *See Polaroid Corp.* v. *Eastman Kodak Co.*, No. 86-604 slip op. at 4-7, 229 USPQ 561 (Fed. Cir. Apr. 25 1986). Here, a patent has issued, a trial has been conducted on 18 dates, much testimonial and documentary evidence has been received and evaluated by a district judge. Assuming *arguendo* that Stora's and the district court's factual interpretations of the prior art were equally permissible, that circumstance would avail it nothing on appeal, for when there are two permissible views of the evidence, the factfinder's choice between them *cannot* be deemed clearly erroneous. *Anderson* v. *City of Bessemer City, N.C.*, ___ U.S. ___, ___, 105 S. Ct. 1504, 1512 (1985). Stora must on appeal establish not only that its view is permissible but that that of the district court is clearly in error.

As all too frequently occurs on appeal, Stora limits its discussion to evidence that tends to support its view, largely ignoring the contrary evidence accepted by the district court. Particularly ignored are the district court's credibility determinations. That approach cannot of itself establish that the district court's findings were clearly erroneous. *See American Original Corp.* v. *Jenkins Food Corp.*, 774 F.2d 459, 462-63, 227 USPQ 299, 300-01 (Fed. Cir. 1985). "Determining the weight and credibility of the evidence is the special province of the trier of fact." *Inwood Laboratories, Inc.* v. *Ives Laboratories, Inc.*, 456 U.S. 844, 856, 214 USPQ 1, 7 (1982).

At trial, Crucible's main witnesses, Mr. Neumeyer and Dr. Tien, testified that the prior art produced inferior cutting tool steels. Neumeyer said Comstock did not attain full density or fine carbides. He added that one practicing the subject matter of the Reen patent would be unable to achieve full density without sacrificing fine carbide size. Dr. Tien stated that Mott dealt with structural alloys from which satisfactory cutting tools could not be produced. That the district court credited that testimony is reflected in its statement:

> We have considered all of the prior art references cited by [Stora] with special attention to those primary sources; i.e., Mott, Comstock and Reen I, and [have] concluded that no prior inventor was able to achieve the requisite combination of high density and finely dispersed carbides necessary to the production of top quality high speed tool steel. Indeed, no prior inventor even regarded such a combination as theoretically possible.

594 F. Supp. at 1257, 226 USPQ at 42 (footnote omitted).

The district court credited the testimony of Mr. Neumeyer and Dr. Tien, and rejected that of Stora's witness, Dr. Lawley. On this record, Stora has shown no "basis on which this court could engage in the normally inappropriate process of substituting a contrary credibility determination for that of the district court." *Windsurfing International Inc.* v. *AMF Inc.*, 782 F.2d 995, 999, 228 USPQ 562, 565 (Fed. Cir. 1986); *see Railroad Dynamics,*

Inc. v. *A. Stucki Co.*, 727 F.2d 1506, 1514, 220 USPQ 929, 937 (Fed. Cir.), *cert. denied*, 105 S. Ct. 220, 224 USPQ 520 (1984).

[3] Moreover, the district court met Stora's contentions head-on, rejecting, for example, its argument that Reen did not have to warn against carbide growth. The district court correctly found, as had the PTO board, that "neither Reen nor Comstock even cautions against carbide growth at elevated temperatures." 594 F. Supp. at 1257 n.9, 226 USPQ at 42 n.9. Indeed, the Reen patent says, "generally the longer the time and higher the temperature, the higher the density of the sintered strip." Comstock, notwithstanding actual knowledge of Mott's carbide size discussion, advises the use of "as high a temperature as possible without melting." Thus, the inventor achieved the invention set forth in claim 30 by doing what those skilled in the art suggested should not be done, i.e., using lower temperatures, a fact strongly probative of nonobviousness. *W. L. Gore & Associates* v. *Garlock, Inc.*, 721 F.2d 1540, 1552, 220 USPQ 303, 312 (Fed. Cir. 1983), *cert. denied*, 105 S.Ct. 172 (1984).

Lastly, the district court's determination that until the disclosure in the '518 patent became available no one could produce the combination of full density and fine carbide size found in the invention set forth in claim 30, and its determination that the limitation to carbides of less than three microns was not, in view of that fact, essential to its nonobviousness conclusion, are fully supported in the record. *See Gardner* v. *TEC Systems, Inc.*, 725 F.2d 1338, 1345-46, 220 USPQ 777, 783-84 (Fed. Cir.), *cert. denied*, 105 S. Ct. 116 (1984).

In arguing that the district court failed to ascertain the differences between the invention set forth in claim 30 and the prior art, Stora has failed to carry its burden on appeal.

(iii) Level of Skill

Stora's contention that the district court committed legal error when it did not find a specific level of skill in the art is equally without merit. In its opinion, the court said "no prior inventor even regarded [the '518 patent] combination as theoretically possible." 594 F. Supp. at 1257, 226 USPQ at 42. In denying a stay of the injunction pending appeal, the court indicated that it had considered the skill of prior inventors, rendering it unnecessary to find some other level of skill:

> In other words, it was not obvious to *anyone* at *any* level of skill in the art prior to [the '518 patent]. Any further reference, finding, or definitions of level of skill in the art, in view of [the finding that no inventor thought the invention of claim 30 theoretically possible,] would have been superfluous.

226 USPQ at 843 (emphasis in original).

The primary value in the requirement that level of skill be found lies in its tendency to focus the mind of the decisionmaker away from what would presently be obvious to that decisionmaker and toward what would, when the invention was made, have been obvious, as the statute requires, "to one of ordinary skill in the art." 35 U.S.C. §103; *see Polaroid Corp.*, *supra*, slip op. at 5.

This court has noted instances in which a particular level of skill finding did not improperly influence the ultimate conclusion under §103. One such instance involved a determination that an invention would have been *obvious* to one of the lowest level of skill, i.e., that of a layman. *See, e.g., Union Carbide Corp.* v. *American Can Corp.*, 724 F.2d 1567, 1573, 220 USPQ 584, 589 (Fed. Cir. 1984); *Chore-Time Equipment, Inc.* v. *Cumberland Corp.*, 713 F.2d 774, 779, 218 USPQ 673, 676 (Fed. Cir. 1983). Another involved a determination that an invention would have been *nonobvious* to those of *extraordinary* skill, i.e., other inventors in the art. *See Standard Oil Co.* v. *American Cyanimid Co.*, 774 F.2d 448, 454, 227 USPQ 293, 297-98 (Fed. Cir. 1985); *Kimberly-Clark Corp.* v. *Johnson & Johnson*, 745 F.2d 1437, 1454, 223 USPQ 603, 614 (Fed. Cir. 1984).

[4] To establish reversible error based on a level of skill finding, it must be shown that that finding led to error in the ultimate conclusion. Stora was not in this case prejudiced by the district court's having looked to other inventors, rather than one of ordinary skill. Stora wastes the time of all concerned in arguing that the district court's treatment of the level of skill constituted reversible error.

(iv) Objective Evidence

As the district court noted, the parties stipulated that the properties of the product set forth in claim 30 have led to substantial commercial success for Crucible and Stora. 594 F.Supp. at 1258, 226 USPQ at 43. Incredibly, Stora attempts on appeal to denigrate that commercial success.

Stora says, without citation to the record, that there is no nexus because powder metallurgy high speed tool steels did not emerge on the market until about 1970, years after the filing date of the application that matured into the '518 patent, that substantial sales were not realized until about 1975, two years after the '518 patent issued, and that some old features contributed to commercial success.

[5] Apart from Stora's apparent and disquieting effort to renege on its stipulation, Stora is

wrong on the law. Mere passage of time may not be enough to discredit nexus with commercial success. *Windsurfing International*, 782 F.2d at 1000, 228 USPQ at 565 ("Absent some intervening event to which success must be attributed, the delay in achieving the great commercial success of the claimed invention in this case does not detract from the probative value of the evidence of that success."). Stora has shown no basis whatever for its attack on the relevance of the commercial success which resulted, as Stora stipulated, from the properties of the invention.

Moreover, the district court attributed proper weight to the other objective evidence in this case, i.e., filling of a longfelt and unsolved need, failure of others, and wide acceptance and recognition of the claimed invention. Stora stipulated to that evidence and has not on appeal attempted to renege on that part of its stipulation.

Conclusion on Nonobviousness of the Invention Set Forth in Claim 30

Stora having failed to discharge its burden on appeal, the portion of the judgment based on the conclusion that the invention set forth in claim 30 of the '518 patent would not have been obvious must be affirmed.

B. Claim 4 of the '934 Patent

(a) Anticipation

Before the district court, Stora argued that Crucible's attempt to provoke an interference between the '934 patent and the application disclosure that resulted in the '518 patent, and Crucible's accompanying "same invention" arguments, were proof that the latter anticipated claim 4 of the '934 patent.[7] Crucible countered with the PTO's refusal to declare the interference.

The district court correctly determined that the events relating to the interference were not controlling because Crucible admitted that size change uniformity is inherent in the alloy disclosed in the '518 patent. The district court found, however, that inherency of size change uniformity was alone insufficient, because "the existence of this inherency alone of merely one element of the claimed invention, does not fulfill the strict requirements of anticipation." 594 F. Supp. at 1262, 226 USPQ at 46.

Stora admits the correctness of the district court's finding that the '518 patent does not disclose hobs. That fact is itself sufficient to require affirmance of the district court's determination that the '518 patent does not anticipate claim 4 of the '934 patent.

(b) Obviousness

The district court distinguished Comstock, Frehser, *Antitropic Dimensional Changes due to Heat Treatment of Ledeburitic Chrome Tool Steels* (Frehser), and Lement, *Distortion in Tool Steels* (Lement), finding that that prior art disclosed processes and alloys all of which failed to achieve the properties produced by the process disclosed in the '934 patent. The court said that Comstock failed to "attain full, or substantially full, density and uniformly distributed fine carbide particles," and that Frehser and Lement did not "even [consider] the production of tool steel through a powder metallurgy process." 594 F.Supp. at 1263, 226 USPQ at 47.

With respect to the prior art represented by the '518 patent, the district court said:

> The principal benefit of the ['934] process is its elimination of the out-of-roundness traditionally characteristic in past methods of producing hobs. This, as we previously noted, is achieved through a hardening treatment phase which maximizes size change uniformity, a property particularly essential for hobs because of the reduction of out-of-roundness and resultant increased dimensional stability. While we find that [the '518 patent] is limited to cutting tools, the ['934 patented] process is [sic, would have been] not obvious.

594 F. Supp. at 1263, 226 USPQ at 47.

After evaluating all of the prior art and the objective evidence, the court concluded that the '934 "process is [sic, would have been] not only nonobvious, but appears to be [sic, have been] revolutionary in its elimination of dimensional instability in hobs." *Id.*

Stora argues that the district court focused on the process disclosed and not on the product claimed in the '934 patent. When Stora made the same argument in connection with its motion to stay the injunction, the district court responded that Stora had argued that similarities in the processes evidenced obviousness in the resulting products, and that the court employed "process" in responding to those arguments of Stora. The court also pointed to the reference in its opinion to the invention of the '934 patent as a "powder metallurgy hob, a cutting tool." 226 USPQ at 843. In addition, the court began its initial opinion with the statement that both patents "protect powder

[7] Though the '518 patent issued after the '934 patent, it is prior art because the application on which it issued was filed earlier. 35 U.S.C. §102(e); *see Hazeltine Research, Inc. v. Brenner*, 382 U.S. 252, 147 USPQ 429 (1965).

metallurgy cutting tool products." 594 F. Supp. at 1250, 226 USPQ at 37.

The burden of proving facts requiring a conclusion of invalidity was on Stora. Having adopted at trial a strategy and tactic involving comparison of the processes disclosed in the prior art and the '934 patent, Stora now seeks to change horses. That it cannot do. First, it would simply be unfair to re-run the race. Second, Stora has not shown that the differences found in the processes by the district court would not serve to produce corresponding differences in the claimed product.

Nor has Stora shown that reversible error resides in the district court's failure to expressly find, as Stora asserts, that the only difference between the invention set forth in claim 4 and the '518 patent disclosure is a hob. The evidence cited in Stora's brief was fully considered by the district court and no basis appears for a conclusion that the court did not fully consider that evidence.

In sum, Stora simply failed to prove at trial facts requiring a conclusion that one skilled in the art and having the disclosure of the '518 patent before him would have found it obvious to have made the invention set forth in claim 4 of the '934 patent at the time it was made.

Stora bases a major argument on the undisputed fact that size change uniformity is an inherent property of the alloy disclosed in the '518 patent. That argument is unpersuasive when confronted by Stora's failure to establish at trial that that inherency would have been obvious to those skilled in the art when the invention of claim 4 was made. Inherency and obviousness are distinct concepts. *W. L. Gore & Associates* v. *Garlock, Inc.*, 721 F.2d 1540, 1555, 220 USPQ 303, 314 (Fed. Cir. 1983) (citing *In re Sporman*, 363 F.2d 444, 448, 150 USPQ 449, 452 (1966)), *cert. denied*, 105 S. Ct. 172 (1984).

Similarly, Stora's argument that the district court failed to give full import to Crucible's disclaimer of claims 1 and 2 is without merit. First, it is based on conjecture respecting Crucible's reasons for the disclaimer (i.e., that Crucible recognized invalidity of those claims). Second, it ignores the statutory provision that each claim must be separately presumed valid. 35 U.S.C. §282. Third, as previously noted, claim 4 includes all of the limitations of claims 1 and 2 and must be viewed as though it had originally been an independent claim.

Conclusion on Nonobviousness of the Invention Set Forth in Claim 4

We have considered each of Stora's other arguments touching on the district court's validity conclusion and find them without merit. Because Stora has not discharged its burden on appeal, the portion of the judgment based on the conclusion that the invention set forth in claim 4 of the '934 patent would not have been obvious must be affirmed.

(2) Inequitable Conduct

The district court correctly determined that Stora had waived its inequitable conduct defense to validity at trial. 594 F. Supp. at 1264–65, 226 USPQ at 48; *see also* 226 USPQ at 844. Stora reserved that matter only as possible support for attorney fees in the event it prevailed before the district court. Having waived the assertion at trial, Stora may not resurrect it on appeal. *Cf. Laitram Corp.* v. *Cambridge Wire Cloth Co.*, 785 F.2d 292, 295, 228 USPQ 935, 937 (Fed. Cir. 1986) (allegation of fraud cannot be raised for the first time in this court). Moreover, in its supplemental opinion, the court expressly found that the Comstock patent was not material and that Stora had therefore failed to carry its burden on inequitable conduct. 226 USPQ at 847. That finding has not been shown to have been clearly erroneous.[6]

(3) Increased Damages - Willful Infringement

In its cross-appeal, Crucible argues that the facts found by the district court mandated an ultimate finding of willful infringement and that such a finding would "[compel] an award of increased damages and attorney fees." The court did not make an express finding on whether Stora's infringement was or was not willful, but limited itself to saying it was unpersuaded that "the evidence including Dr. Hellman's memorandum is sufficient to constitute a basis for treble damages."

The underlying facts are undisputed, and the sole question at this point is whether an ultimate finding of non-willful infringement would be clearly erroneous in light of those underlying facts. If we determine that a finding of non-willfulness would be clearly erroneous, and that a finding of willfulness is dictated by the undisputed underlying facts, we do not thereby engage in *de novo* fact finding, for there are only two possibilities: the infringement here was either willful or it was not. If a finding that it was not would be clearly erroneous, the only alternative is a finding that it

[6] Stora's allegation that Crucible's failure to cite the Comstock reference to the PTO constituted inequitable conduct was also rejected by the PTO. *See In re Holtz*, 224 USPQ 714 (Bd. App. 1984).

was. In that circumstance, a remand to the district court for the purely ministerial task of entering a necessary and foreordained finding serves no useful purpose and merely wastes judicial resources.

Before the district court, Crucible relied mainly on a February 5, 1973 internal memorandum of the chief technical expert of Stora, Dr. Hellman. The memorandum was written after a meeting between Crucible and Stora officials, during which Crucible warned Stora that its products would infringe certain allowed claims, before issuance of the '518 patent, and long before Stora commenced its infringement in the United States. The memorandum read:

Summary:

Crucible maintains that additional patent claims, based on an old patent application, have now been approved in the USA and that these patent claims are so worded that we are infringing on them by selling ASP-steel in the USA. We have for now no possibilities for checking this, but must as a matter of course proceed [on the assumption] that it is true. A new search for prior art has been started and the material that has come to hand will be evaluated at the latest by April 15th If enough solid prior art are found by them, we can bring an action against Crucible and begin to sell ASP-steel in the USA. If the new patent claims, on the other hand, should be judged to be valid, we will be closed out of the American market for the foreseeable future.

* * *

In the USA and Canada, the conditions are more difficult than in other countries because of differences in the patent laws. In these other countries, we will sell ASP-steel without waiting for the results of the respective reports.

* * *

"Stevens" USPat 3.561.934
All the claims refer to: (As) an *article* of manufacture, a metal body constructed of compacted particles of high speed tool or die steel composition. This protects, in other words, the product and he who imports such products to the USA infringes [on the patent]. We are of the opinion in the meantime, that the patent is *not tenable*. See the special memo on this.

* * *

Crucible made it fully clear that they will sue us for patent infringement as soon as they detect that we have begun to sell ASP-steel in the USA. Apparently they have given the same information to our potential customers in the USA. Further, they notified us that at least for the present they do not intent to sell licenses to anybody. If their product is successful, the American authorities can eventually force them to sell licenses to at least one company which is in a position to make a similar product. Theis possibility is, in the meantime, unsure and lies a long way in the future. On the other hand, Crucible declared itself willing to discuss a license agreement which would only cover Sweden (!) a suggestion which was not answered.

American courts have divergent attitudes toward patents and if this question goes to court, it is important that we take the initiative so that we can choose the right court.

Up to now our efforts have naturally been concentrated on preparations to get the Stevens-patent declared invalid. The following *measures* are being taken now with the above mentioned new patent claims in mind:

1) Search for prior art in the American Patent Office (Curtis, Morris & Safford).

2) Search for prior art in the remaining patent literature (patent section, Falun).

3) Search for prior art in the technical literature (lab., Soderfors).

4) Evaluation of the found material. Shall be finished by April 15, 1973 at the latest.

Here, as in the other patent questions, we will work together with ASEA. In all likelihood, we will also turn to IIB (The Interational Patent Institute in The Hague) for certain types of research.

If the evaluation gives the right result, we will request a "declaratory judgment action"; that is, we will request that the Stevens-patent be declared invalid. The same measures will be taken against the new Holtz claims as soon as they are made public. As soon as we have filed the former suit, we can begin to sell ASP-steel in the USA but until then we must lie low. This will not involve any noteworthy delay in the introduction of ASP-steel as we must first build up a stock.

During the search for oppositions, we will not come to find directly lethal material, but instead we have to concentrate on finding 2 or at most 3 documents which taken together make it "obvious to the professional" that good powder steel can be made and how. An eventual trial will come to be

decided on the credibility of the experts' testimony. Our American patent lawyer has guessed at the time and cost for such an action if a compromise were not to be reached: A judgment in the district court will in all likelihood take around two years and the costs will certainly be $50,000, perhaps up to $100,000 dollars, of which the main part will be spent at the beginning of the action and when the trial itself begins. After the appeal to the court of appeals, the judgment will be delayed a further 6-12 months and the costs will rise by 10 to 15 thousand dollars. We must count on having to pay our costs irrespective of the outcome. The damages that we can be assessed if we lose has been guessed to be 5 or possibly up to 10% of the value of the sales.

If the evaluation of the forthcoming oppositions prior art should indicate that the new patent claims in the Holtz application are valid, then the American market is closed to us for the foreseeable future.[9]

* * *

The district court found that the memorandum: (1) was based on Stora's assumption that it would be infringing the allowed claims, as to which assumption Dr. Hellman stated "we have no possibilities for checking . . . ."; (2) assumed the patents valid and infringed and merely "charted a strategy to check patent validity; contest patent validity; and, in the process, to get [Stora's] products into the United States market;" and (3) "assessed the costs and prospects of litigation upon the further assumption that "the evaluation give the right result.' " 594 F. Supp. at 1264, 226 USPQ at 48.

The district court also refused to award treble damages because it found that Stora litigated close patent issues saying those issues "presented substantial questions upon which there has been genuine debate and honest disagreement . . . ." 594 F. Supp. at 1264, 226 USPQ at 48. The court noted that awards of treble damages might "thwart good faith efforts to contest patent validity." *Id.* (citing *Yoder Brothers, Inc.* v. *California-Florida Plant Corp.*, 537 F.2d 1347, 1383, 193 USPQ 264, 296 (5th Cir. 1976), *cert. denied*, 429 U.S. 1094 (1977)). The court noted also that when Crucible told Stora of the patents, Stora replied that the patents were invalid in view of Comstock and a 1964 Holtz article. Concluding that Crucible had not overcome Stora's claims of good faith, the district court mistakenly referred to §284 instead of §285 in its refusal to find this to be such an "exceptional case, under 35 U.S.C. §284 (1982) [sic], to justify the award of treble damages." 594 F. Supp. at 1264, 226 USPQ at 48.

[6] That the district court declined to impose inceased damages that *may* accompany a finding of willful infringement does not mean that the court found the infringement not willful. *See, e.g., S. C. Johnson & Son, Inc.* v. *Carter Wallace, Inc.*, 781 F.2d 198, 201, 228 USPQ 367, 369 (Fed. Cir. 1986). Though the parties have proceeded on appeal as though the district court had found Stora's infringement not willful, all the district court decided was that it would not award treble damages. It appears that the court felt that if it found Stora's infringement willful it would have been required to award treble damages. If that be so, it may be said that the court implicitly found Stora's infringement not willful. If that implicit finding was made, it was clearly erroneous.

The district court did not have before it, of course, the guidance on the law of willful patent infringement provided by this court since the time of the trial. *In Underwater Devices*, this court stated:

> Where, as here, a potential infringer has actual notice of another's patent rights, he has an affirmative duty to exercise due care to determine whether or not he is infringing. Such an affirmative duty includes, *inter alia*, the duty to seek and obtain competent legal advice from counsel *before* the initiation of any possible infringing activity. [Citations omitted.]

Id. at 1389-90, 219 USPQ at 576 (emphasis in original).[10]

Though it is an important consideration, not every failure to seek an opinion of competent counsel will mandate an ultimate finding of willfulness. *King Instrument Corp.* v. *Otari Corp.*, 767 F.2d 853, 867, 226 USPQ 402, 412 (Fed. Cir. 1985), cert. *denied*, 106 S. Ct. 1197 (1986) (court "should always look at the totality of the circumstances"). Conversely, that an opinion of counsel was obtained does not always and alone dictate a finding that the infringement was not willful. *See, e.g., Kori Corp.* v. *Wilco Marsh Buggies & Draglines Inc.*, 761 F.2d 649, 656, 225 USPQ 985, 989

[9] The quoted paragraphs are reproduced exactly as they appear in the translation set forth in the appendix. [Ed. Note: Printing restraints prevented the exact reproduction of these paragraphs. For their exact reproduction, see the Court's slip opinion.]

[10] The determination referred to includes, of course, one on validity, there being no liability for infringment of invalid claims.

(Fed. Cir.), *cert. denied*, 106 S. Ct. 230 (1985); *Central Soya Co.* v. *George A. Hormel & Co.*, 723 F.2d 1573, 1576-77, 220 USPQ 490, 492-93 (Fed. Cir. 1983). In the present case, the totality of the circumstances, including the failure to seek advice of counsel, makes any finding of non-willfulness clearly erroneous and compels the only alternative finding, i.e., that Stora's infringement was willful.

On the undisputed facts of record, an ultimate finding that Stora's infringement was not willful would be "incompatible with the applicable findings [the court] clearly articulated" and would thus, as above indicated, be clearly erroneous. *CPG Products Corp.* v. *Pegasus Luggage, Inc.*, 776 F.2d 1007, 1015, 227 USPQ 497, 502 (Fed. Cir. 1985). Stora has not shown to have been clearly erroneous the underlying findings (e.g., that Stora proceeded with its infringement on the assumption, as stated in the memorandum and found by the district court, that the patents were valid and would be infringed). Those findings fully support the present determination that an ultimate finding of non-willfulness would be clearly erroneous.

Stora has not even asserted that it sought advice of counsel when notified of the allowed claims and Crucible's warning, or at any time before it began this litigation. Stora's silence on the subject, in alleged reliance on the attorney-client privilege, would warrant the conclusion that it either obtained no advice of counsel or did so and was advised that its importation and sale of the accused products would be an infringement of valid U.S. patents.

The internal memorandum of Dr. Hellman, a non-lawyer, clearly shows that Stora intentionally undertook the risk of importing infringing products in the hope that a court would hold the patent invalid, or that Crucible would grant a license to escape litigation. The '518 patent issued almost a full year before Stora began its infringement in the United States. The district court's characterization of the memorandum as "merely [evidencing] an aggressive strategy of contesting patents" may relate to a reason for infringing; it cannot serve as a basis for finding Stora's infringement not willful. That Stora's officials told Crucible, as part of that "strategy", that they thought the patents invalid in view of certain prior art cannot substitute for the advice of competent counsel before the onset of infringement and is contrary to Stora's own internal memorandum."

" We do not here evaluate Stora's strategy. An aggressive strategy may or may not be a factor in a decision to deny or award increased damages. An "aggressive strategy" unsupported by any competent advice of counsel, thorough investigation of validity and infringement, discovery of more pertinent uncited prior art, or similar factors, is the type of activity the reference in the patent law to increased damages seeks to prevent. An alleged infringer who intentionally blinds himself to the facts and law, continues to infringe, and employs the judicial process with no solidly-based expectation of success, can hardly be surprised when his infringement is found to have been willful.

If infringement be accidental or innocent, increased damages are not awardable for the infringement. If infringement be willful, increased damages "may" be awarded at the discretion of the district court, and the amount of increase may be set in the exercise of that same discretion.

Our indication that Stora's infringement must on this record be found willful does not, therefore, mandate an award of increased damages. The district court has not determined whether, if Stora's infringement were found willful, it would deem increased damages appropriate. Nor has it determined what level of increase, if any, would be appropriate. We therefore express no view on whether the district court, in the exercise of its discretion, should or should not award increased damages as a part of its determination of the damage issues it reserved for later trial. *See CPG Products Corp.*, 776 F.2d at 1015, 227 USPQ at 502.

(4) Attorney Fees

Having determined that this case was not "exceptional", the district court declined to award treble damages and did not mention either §285 or attorney fees *per se*. Willfulness of infringement relates to the accused infringer's conduct in the marketplace. Because that conduct may be seen as producing an unnecessary and outcome-certain law suit, it may make the case so exceptional as to warrant attorney fees under §285. Similarly, bad-faith displayed in pretrial and trial stages, by counsel or party, may render the case exceptional under §285.

When a court declines to award attorney fees on the basis of a determination that a case is not exceptional, the fact findings underlying that determination are reviewed under the clearly erroneous standard. When the determination is that a case is exceptional, the election to grant or deny attorney fees is reviewed under the abuse of discretion standard. *Reactive Metals and Alloys Corp.* v. *ESM, Inc*, 769 F.2d 1578, 1582-83, 226 USPQ 821, 824 (Fed. Cir. 1985).

We join the district court's concern that awards of increased damages and attorney fees

not be allowed to thwart efforts to challenge the validity of patents believed in good faith to be invalid. A party who has obtained advice of competent counsel, or otherwise acquired a basis for a *bona fide* belief that a patent is invalid, can be said to serve the patent system in challenging that patent in a law suit conducted fairly, honestly, and in good faith. Such a party should not have increased damages or attorney fees imposed solely because a court subsequently holds that belief unfounded, particularly when the issues may be fairly described as "close".

As above indicated, a court may find that in all the circumstances an infringement was so willful as to justify a determination that a case is exceptional, and a court may thereupon exercise its discretion to award attorney fees to the patentee. *See Standard Oil Co.* v. *American Cyanamid Co.*, 774 F.2d 448, 455, 227 USPQ 293, 298 (Fed. Cir. 1985); *Milgo Electronic Corp.* v. *United Business Communications, Inc.*, 623 F.2d 645, 667, 206 USPQ 481, 498 (10th Cir.), *cert. denied,* 449 U.S. 1066, 208 USPQ 376 (1980). Because there is here no express finding on whether Stora's infringement was so willful as to render the case exceptional, we leave the question in the present case to the district court's determination and discretion in conjunction with the reserved damage trial.

Respecting other possible bases for awarding attorney fees, the district court, in discussing treble damages, found that Stora's claims of good faith were not overcome by the evidence, and that the patent validity issue presented substantial questions on which there had been honest disagreement in the PTO and at trial. Those findings would be applicable in considering a request for attorney fees under §285. Because the district court did not expressly award or refuse attorney fees under §285, there is no basis for this court's review of those findings. There having been no denial of attorney fees *per se* under §285, we leave that question also to such further proceedings as the district court may deem appropriate.

(4) The Injunction [12]

It is undisputed that Kloster was created immediately after conclusion of the trial and long before judgment, and that, before the court's decision, it purchased the facility Stora used to manufacture the products found to infringe. The effort of Stora to evade the effect of any possible injunction by divesting itself of its facilities for producing infringing products, the effort of Kloster to evade the injunction and thus gain freedom to continue the infringement and force Crucible to a second lawsuit, and the continuation of those efforts by appeal to this court, do not reflect the highest ethical standards of either the business community or the legal profession.

On September 4, 1984, i.e., fifteen days before the district court issued its opinion, Crucible moved to join Kloster as a party pursuant to Fed. R. Civ. P. 19(a) and 25(c).[13]

The court's opinion issued September 19, 1984, indicated that infringement by Stora and its "successors in interest and assigns" would be enjoined. On October 5, 1984, Kloster appeared at a status conference and argued that it should not be joined as a party and that "successors in interest and assigns" should be deleted from the proposed injunction. On October 11, 1984, the court issued its injunction enjoining infringement by Stora and its "successors in interest and assigns." The court deemed it unnecessary to decide the joinder question. Kloster moved to modify the injunction by deleting "successors in interest or assigns" or by specifically excluding Kloster. In denying the motion, the court cited *Regal Knitwear Co.* v. *National Labor Relations Board,* 324 U.S. 9 (1944) as authority for its use of "successors in interest and assigns." 226 USPQ at 846.

[7] Kloster was not a party when the judgment was entered. Nonetheless, because it must be deemed a successor in interest or an assign, it is bound by the injunction and may for that reason appeal the refusal to modify it. *See* 9 J. Moore, B. Ward & J. Lucas, *Moore's Federal Practice* ¶203.06, at 3-23 (1985); *see, e.g., Zenith Radio Corp.* v. *Hazeltine Research Inc.*, 395 U.S. 100, 108-112, 161 USPQ 577, 580-82 (1969); *see also United States* v. *LTV Corp.*, 746 F.2d 51, 53-54 n. 5 (D. C. Cir. 1984).[14]

Kloster attempted to carry water on both shoulders before the district court. It effectively

[12] The injunction reads:

Each of the defendants, their officers, agents, servants, employees, successors in interest and assigns, and any other person, corporation, or organization acting in concert with them is hereby permanently enjoined and restrained during the life of the respective U.S. patents identified above from the making, using or selling of products infringing claim 30 of U.S. Patent No. 3,746,518 or claim 4 of U.S. Patent No. 3,561,934, and from inducing or contributing to the making, using or selling of such products.

[13] Kloster at no time sought to intervene under Fed. R. Civ. P. 24(a).

[14] Having neither intervened before the trial court nor argued that Stora is incapable of contesting the merits on appeal, Kloster is without standing to appeal from the judgment on the merits. The brief it filed on the merits has accordingly been disregarded.

asserted it was not bound, when it contested joinder, declined intervention, and sought specific exclusion. It effectively asserted that it was bound, when it sought modification of the injunction, because absent such assertion Kloster would lack standing to contest the injunction's terms. In all events, the district court correctly intended that Kloster be bound by the injunction.

At the status conference, the court said, "the most significant feature of Rule 25(c) is that it does not require that anything be done after an interest has been transferred. The action may be continued by or against the original party and the judgment will be binding on his successor in interest, even though he is not named." [15] (Quoting 7A C. Wright & A. Miller, *Federal Practice and Procedure*, §1958, at 664 (1972); *see also, Minnesota Mining & Manufacturing Co.* v. *Eco Chem Inc.*, 757 F.2d 1256, 1263–64, 225 USPQ 350, 354–55 (Fed. Cir. 1985) (joinder merely a determination that transferee's presence would facilitate conducting the litigation)).

On appeal, Kloster says that the district court "sought to evade the limitations" of Fed. R. Civ. P. 65(d)[16] when it inserted "successors in interest and assigns." Kloster quotes from *Regal Knitwear Co.*, 324 U.S. at 14: "The terms "successors and assigns' in an enforcement order of course may not enlarge its scope beyond that defined by the Federal Rules of Civil Procedure." Kloster disregards and distorts the thrust of *Regal Knitwear Co.*, in which the Supreme Court affirmed a *denial* of a motion to strike "successors and assigns" and said that "successors and assigns" may *not* be impermissible under Rule 65(d) and *may* be effective to bind those in privity with the defendant. In *Regal Knitwear Co.*, the Court did not have a successor or assignee before it. In *Golden State Bottling Co.* v. *National Labor Relations Board,* 414 U.S. 168, 177–80 (1973), it affirmatively held that the successor party there before it was subject to the enforcement order involved, and went on to clarify the absence of conflict between Rule 65(d) and orders binding successors and assigns.

In *Regal Knitwear Co., following* the sentence quoted by Kloster, the Court wrote:

> Successors and assigns may, however, be instrumentalities through which defendant seeks to evade an order or may come within the prescription of persons in active concert or participation with them in violation of an injunction. If they are, by that fact they are brought within the scope of contempt proceedings by the rules of civil procedure.[17]

324 U.S. at 14. The Court stressed that the emphasis "is not merely to succession, but to a relation between the defendant and the successor which might of itself establish liability within the terms of Rule 65." 324 U.S. at 15. The relation here is not disputable. Kloster is the successor-operator of Stora assets used to produce infringing products.

Kloster argues, however, that the district court "avoided giving any consideration to the relationship" between Kloster and Stora, did not "find" it in privity with Stora, did not give it a chance to show it was not in privity, and cannot bind it with Stora solely because it purchased Stora's infringing facility, citing an agreement between Kloster and Stora that Kloster accepted no liability for Stora's infringement. Kloster argues that it cannot be bound because it was not a party, disregarding its resistance to Crucible's motion to join it. Private agreements between Kloster and Stora are irrelevant. Kloster also argues that it should be entitled to litigate the case on the merits before being enjoined. The arguments are spurious.

Courts have repeatedly found privity where, after a suit begins, a nonparty acquires assets of a defendant-infringer. *See, e.g., Brunswick Corp.* v. *Chrysler Corp.*, 408 F.2d 335, 338, 161 USPQ 65, 67 (7th Cir. 1969); *J. R. Clark Co.* v. *Jones & Laughlin Steel Corp.*, 288 F.2d 279, 280, 129 USPQ 97, 98-99 (7th Cir.), *cert. denied*, 368 U.S. 828 (1961); *Alb, Inc.* v. *Noma Lites, Inc.*, 231 F.2d 662, 663, 109 USPQ 26, 27 (2d Cir. 1956). The applicable reasoning was well illustrated in J. R. Clark Co.:

> If a third party may thus come into the acquisition of rights involved in pending litigation without being bound by the final judgment, and require a suit de novo in order to bind him, he might, pending that suit, alienate that right to another with the same result, and a final decree bearing fruit could never be reached.

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[15] Thus it was not necessary that the court rule on Crucible's motion to join Kloster.

[16] Rule 65(d) provides:

> Every order granting an injunction . . . is binding only upon the parties to the action, their officers, agents, servants, employees, and attorneys, and upon those persons in active concert or participation with them who receive actual notice of the order by personal service or otherwise.

[17] Quoting part of a statement out of context, while ignoring a portion that totally undermines the proposition for which the quote was offered, reflects a reprehensible and unprofessional dereliction of the duty of candor owed the court. *See* Model Rules of Professional Conduct Rule 3.3 (1983); *accord* Model Code of Professional Responsibility DR 7-102(A)(2), DR 7-106(B)(1) (1981).

288 F.2d at 280, 129 USPQ at 98 (quoting G. & C. Merriam Co. v. Saalfield, 190 F.2d 927, 932 (6th Cir. 1911)).

Nowhere does Kloster appear to recognize that it can avoid the injunction by simply refraining from infringement. That it desires to continue Stora's infringement appears the only possible basis for its strenuous effort to evade the injunction.

The district court's denial of Kloster's motion to modify the injunction is affirmed.

CONCLUSION

The judgment refusing to hold invalid claim 30 of the '518 patent and claim 4 of the '934 patent, and refusing the inequitable conduct defense, is affirmed. To the extent that the district court's refusal of treble damages rested on an implicit finding that Stora had not willfuly infringed, that finding was clearly erroneous, and the request for increased damages and attorney fees is remanded. The denial of Kloster's motion to modify the injunction is affirmed.

AFFIRMED IN PART AND REMANDED IN PART.

Court of Appeals, Seventh Circuit

In Re Innovative Construction Systems, Inc.

No. 85-1142

Decided June 17, 1986

UNFAIR COMPETITION

1. Pleading and practice in courts — Judgments (§53.53)

Trade secrets — In general (§68.901)

Evidence, in misappropriation of trade secrets action, from which jury could infer that plaintiff took reasonable precautions to limit knowledge among its employees of formulas for its simulated brick paneling, that such formulas were disclosed to former employee in confidence and under pledge of secrecy, and that competitor would have difficulty replicating formulas without resorting to improper means, supports reversal of judgment notwithstanding verdict.

2. Accounting — Damages — Trademarks and unfair competition (§11.258)

Jury's award of $225,000 for misappropriation of trade secrets, which was based on testimony of expert witness whose valuation of plaintiff's business at $246,000 was found to be virtually without foundation, is not reasonable.

3. Accounting — Damages — Trademarks and unfair competition (§11.258)

Showing, in misappropriation of trade secrets claim, of breach of faith alone is insufficient to warrant award of punitive damages, since breach of faith underlies every trade secret claim, but rather award of punitive damages must be based on demonstration that defendant also acted wantonly, wilfully, or in reckless disregard of plaintiff's rights.

Appeal from District Court for the Western District of Wisconsin, Shabaz, J.

Action by Innovative Construction Systems, Inc., against Bowen Supply, Inc., Sunbelt Brick Company, Inc., Harold Bowen and Phillip Strand, for misappropriation of trade secrets, breach of implied covenant of good faith under Wisconsin Law, unfair competition, and antitrust violations. From judgment for defendants, plaintiff appeals. Reversed and remanded.

Earl Munson, Jr. and LaFollette, Sinykin, Anderson & Munson, both of Madison, Wisc., for appellant.

Edwin J. Hughes and Stafford, Rosenbaum, Rieser & Hansen, both of Madison, Wisc., for appellee.

Before Eschbach, Esterbrook, and Ripple, Circuit Judges.

Eschbach, Circuit Judge.

The primary questions presented on appeal in this diversity action[1] governed by Wisconsin law are whether (1) the defendants misappropriated the plaintiff's trade secrets (2) the award of compensatory damages was excessive, and (3) the award of punitive damages

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[1] The plaintiff filed a petition in United States Bankruptcy Court for the Western District of Wisconsin requesting relief under Chapter 11 of the Bankruptcy Code, 11 U.S.C. §§ 1101-1174. It then initiated adversary proceedings in that court against the defendants, which proceedings were transferred to federal district court. The district court had jurisdiction under both 28 U.S.C. § 1332(a), owing to the diverse citizenship of the parties, and under 28 U.S.C. § 1331, based on Innovative's various federal claims. We have jurisdiction pursuant to 28 U.S.C. §1291.